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Rating the relevance of QUORUM-selected ASRS incident narratives to a "controlled flight into terrain" accident

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Summary

An exploratory study was conducted to identify commercial aviation incidents that are relevant to a "controlled flight into terrain" (CFIT) accident using a NASA-developed text processing method. The QUORUM method was used to rate 67820 incident narratives, virtually all of the narratives in the Aviation Safety Reporting System (ASRS) database, according to their relevance to two official reports on the crash of American Airlines Flight 965 near Cali, Colombia in December 1995. For comparison with QUORUM's ratings, three experienced ASRS analysts read the reports of the crash and independently rated the relevance of the 100 narratives that were most highly rated by QUORUM, as well as 100 narratives randomly selected from the database.

QUORUM successfully retrieved a large proportion of incidents that are relevant to the Cali accident. Eighty-four of 100 QUORUM-selected narratives were rated as relevant to the Cali accident by one or more of the analysts. Each analyst rated approximately two-thirds of the QUORUM-selected narratives as relevant. Over two-thirds of the incidents retrieved by QUORUM were rated as relevant to the context, events, problems, or human factors of the Cali accident. Over half of the incidents were rated as relevant to the causes of the accident. In addition, the QUORUM collection of incidents was found to be significantly more relevant than the random collection.

The 84 incidents that were rated as relevant to the Cali accident involved a variety of factors, including over-reliance on automation, confusion and changes during descent/approach, terrain avoidance, and operations in foreign airspace.

These results show that a QUORUM-derived query model based on accident reports can be used successfully to retrieve relevant incident reports.

Introduction

The relevance of commercial aviation incidents to accidents is not firmly established by hard data, but most analysts believe that incidents and accidents are importantly related. Aviation accidents, which are relatively rare, involve major injury to persons, significant damage to property, or both. Incidents are more common, but do not result in significant damage or injury. Many aviation experts (e.g., Miller, 1998a; Miller, 1998b) have long felt that accidents generally involve chains of causation among otherwise relatively minor factors that, taken together, lead to serious consequences. These minor factors, occurring in isolation, might otherwise result in an incident. By identifying accident factors that also occur in numerous incidents, it may be possible to break critical links in the chain of causation.

The Cali accident

On the night of December 20, 1995, American Airlines Flight 965, a Boeing 757 carrying 163 passengers and crew on a regularly scheduled flight from Miami, Florida to Cali, Colombia, crashed into the side of a mountain, just short of its summit (NTSB, 1996a; NTSB 1996b; McKenna, 1996a; McKenna, 1996b; Kaiser, 1996). Only 4 passengers survived the crash. This crash is classified as a CFIT (controlled flight into terrain) accident. According to Duke (1996), "CFIT remains the leading killer of airliner occupants, far exceeding windshear or midair collisions." For that reason, preventing CFIT accidents is a high priority (Shifrin, 1998; McKenna, 1998a; McKenna, 1998c; Anon., 1998; Roberts, 1996; Scott, 1996).

Because the accident happened in Colombia, it was investigated by Aeronautica Civil of the Government of Colombia. In accordance with international protocol, assistance was provided by the U.S. National Transportation Safety Board (NTSB), the U.S. Federal Aviation Administration (FAA), American Airlines, the Allied Pilots Association, Boeing Commercial Airplane Group, and Rolls Royce, Inc. In September, 1996, Aeronautica Civil issued its report (Aeronautica Civil, 1996). In response to the accident and the Colombian report, the U.S. National Transportation Safety Board issued recommendations in the form of a letter to the Federal Aviation Administration, dated October 16, 1996 (NTSB, 1996c).

These two official government accident report documents cite a number of factors that contributed to the Cali accident. These factors include, but are not limited to:

- execution of a GPWS (ground proximity warning system) escape maneuver without retracting speed brakes and without angle of attack information other than the stick shaker,
- loss of situational awareness by the flight crew,
- failure to recognize loss of situational awareness,
- additional workload imposed by a runway change during an automation-aided approach,
- the effect of time pressure on execution of procedures,
- over-reliance on the FMS (flight management system),
- the loss of waypoint data when a direct clearance was entered into the FMS,
- the potential for confusion when non-standard names are used for standard terminal arrival routes,
- the potential for confusion of two proximal navigation beacons having the same identifier,
- use of the wrong navigational beacon,
- an unintended aircraft maneuver,
- inadvertent course deviation,
- miscommunication between flight crew and controller (especially given the language and cultural differences),
- over-reliance on ATC (air traffic control),
- problems with crew decision-making,
- the lack of commonality between instrument approach charts and FMS displays,
- the lack of detailed terrain information on approach charts,
- the lack of terrain information on FMS displays,
- the lack of radar coverage when accustomed to having it,
- possible problems associated with commercial aviation operations in Latin America.

ASRS incidents

While commercial aviation accidents are relatively infrequent and typically involve seemingly unique combinations of circumstances, commercial aviation incidents are more common and can sometimes be seen to fall into patterns. Since the causes of incidents are thought to be related to the causes of accidents, considerable effort has gone into collecting incident reports for analysis of their safety implications. Many aviation safety databases are currently in operation, each with its own purposes and characteristics. (For examples of U.S. government databases, see FAA, 1998). The Aviation Safety Reporting System (ASRS) database is of particular interest because it contains a large number of narratives written by those who directly observed, and usually participated in, the incidents themselves.

According to the Federal Aviation Administration (FAA, 1998), "The Aviation Safety Reporting System (ASRS) is a voluntary, confidential and anonymous incident reporting system. It is a cooperative program established under FAA Advisory Circular No. 00-46D, funded by the FAA and administered by NASA. Information collected by the ASRS is used to identify hazards and safety discrepancies in the National Aviation Airspace System. It is also used to formulate policy and to strengthen the foundation of aviation human factors safety research."

The ASRS has been a major clearinghouse of commercial aviation incident reports for over 20 years (Reynard, Billings, Cheaney, and Hardy, 1986; ASRS, 1998). The ASRS has received and processed over 300,000 incident reports, including over 30,000 in 1997 alone. Nearly 70,000 reports are fully documented in the ASRS database. Reports are typically submitted by flight crews, but there are also many submissions by air traffic controllers, cabin crews, ground crews, and others. Each report in the database includes a narrative section, as well as specialized data fields to aid in classification and statistical analyses. Many narrative sections include only the original narrative received from the incident reporter, but some contain additional material. This can include supplemental information obtained from the incident reporter through "callback conversations," as well as original narratives from others reporting the same incident. Figure 1 shows a typical incident report.

QUORUM text processing

QUORUM is a collection of NASA-developed methods and software for analyzing, modeling, and relevance-ranking text such as the narratives in the ASRS database. QUORUM models text as a list of word pairs, each accompanied by a measure of their contextual relatedness, the proximity-weighted co-occurrence metric. Taken together, these pair-wise word relations constitute a weighted network model of the text. QUORUM relevance-ranks text by comparing QUORUM models.

In a recent study (McGreevy, 1997), QUORUM was used to relevance-rank sentences from a collection of news stories describing the crash of TWA Flight 800, as well as

narratives and sentences from various collections of ASRS narratives. The criteria of relevance included typicality within a collection, typicality with respect to text outside the collection, association with one or more topics, and similarity to example narratives. For example, QUORUM was used to rank sentences from ASRS narratives according to their relevance to the news stories, and to rank the narratives in a collection according to their similarity to particular narratives of interest. In addition to modeling for relevance-ranking, QUORUM modeling has been used for fine-grained analysis of a collection of mode-related ASRS narratives (McGreevy, 1996). Earlier work, in which the QUORUM method was initially developed, involved modeling of scientific text describing satellite-based volcanology (McGreevy, 1995).

In previous studies, QUORUM was applied to collections containing up to hundreds of ASRS narratives. In the present study, QUORUM was applied to all of the narratives in the ASRS database that were available at the start of the study, a collection of 67820 narratives. In earlier studies, QUORUM relevance-ranked hundreds of ASRS narratives based on a few other narratives or on approximately 100 brief news accounts of an aviation disaster. In the present study, QUORUM was used to rank all of the narratives of the ASRS database according to their relevance to two official government accident reports. Finally, this is the first QUORUM study in which ASRS analysts have rated the results.

Design of the study

This was an informal, exploratory study, designed to obtain the first relevance ratings of QUORUM-selected narratives by qualified ASRS analysts. The study was primarily intended to see if a useful proportion of relevant incidents might be retrieved by using an accident report as the source of the query model. The study was further intended to provide some insight into the nature of the operational topics contained in the relevant incidents, and whether those topics might have a bearing on the prevention of future accidents.

From the point of view of improving QUORUM's performance, the study was intended to provide insight into the similarities and differences between QUORUM's ratings of relevance and those of analysts. The use of six different assertions of relevance was intended to provide information regarding the kinds of relevance found among QUORUM-selected reports. This is of particular interest to those seeking incidents having relevance to the causes of the Cali accident.

In addition to the informal, exploratory questions above, the study also involved the experimental question of whether QUORUM performs significantly better than chance. Thus, as a control, 100 randomly selected narratives were also rated by the analysts. This provides one estimate of the distribution in the ASRS database of narratives that are relevant to the Cali accident. Without the control, it would be difficult to interpret QUORUM's performance. The tested hypothesis was: The mean relevance rating of incidents in the collection of QUORUM-selected incidents is significantly higher than the estimated mean relevance rating of the 67820 incidents from the ASRS database.

Method of the study

Two official government documents that describe and analyze the Cali accident were used to rank 67820 incident narratives from the Aviation Safety Reporting System (ASRS) database according to their relevance to the Cali accident. The 100 narratives having the highest relevance-ranking values were selected for inclusion in the study. An additional 100 incident narratives were selected at random from among the 67820 narratives. None of the narratives in the random collection were also among the 100 narratives of the relevance-ranked collection. Three professional incident analysts from the ASRS read the Cali documents, and read and rated each of the 200 incident narratives according to their relevance to the Cali accident. The analysts had no indication of QUORUM's ratings, nor did they know that half the incidents had been selected randomly.

Analysts

Each of the analysts has had extensive experience in commercial aviation operations. The analysts include:

- a retired air carrier pilot with 50 years of aviation experience including 8 in the U. S. Air Force, 33 with a major U. S. air carrier, and 9 as an ASRS analyst;
- a retired air traffic controller with 33 years experience at tower, TRACON, and center facilities and 6 months experience as an analyst at the ASRS, and;
- a retired corporate pilot with 22 years of flying experience and 9 years experience as an analyst and research scientist at ASRS.

Procedure

Modeling the Cali documents— QUORUM was used to model the Cali documents and to generate a query model based on those documents. The method is described in detail in appendix 1. QUORUM methods are described in even greater detail in

McGreevy (1997), McGreevy (1996), and McGreevy (1995). In modeling text, QUORUM generates lists of word pairs that are often found in close proximity in the text. For each word pair, it calculates a proximity-weighted co-occurrence metric. This metric indicates the tendency of the two words to be found in the same context. A word pair and the corresponding relational metric value (RMV) is called a QUORUM relation. The initial model of the Cali documents consisted of 5000 QUORUM relations, while the query model consisted of 2436 QUORUM relations (table 1). So-called "stop words" (e.g., the, is, was, and, or, though) were not included in the model. Because all text in the ASRS narratives (and their models) is in uppercase format, the Cali documents were capitalized prior to modeling. All of the text in the Cali documents was used, including not only the body of the text, but also such text as the table of contents, headers, tables, lists, and references.

The initial model of the Cali documents could be used directly as a query model, but this has two major drawbacks. First, the vocabulary of the Cali documents does not match the abbreviations of the ASRS narratives. Second, use of the document model tends to retrieve incidents that are relevant in a highly generic way. In particular, the incidents tend to involve the approach phase, but without emphasis on the aspects of the Cali accident that make it unusual.

To eliminate the vocabulary mismatch problem, the prominent Cali vocabulary was mapped to the ASRS database abbreviations prior to modeling. For example, the word pair "first officer" was mapped to "FO" and the word "approach" was mapped to "APCH". These mappings would be unnecessary if a collection of ASRS incident reports were used to generate the query model because the vocabulary would be identical.

To eliminate the problem of retrieving generic incidents, the initial model of the Cali documents was transformed. The relational metric value of each word pair in the initial document model was divided by the relational metric value of that word pair in all 67820 narratives from the ASRS database. This tends to disfavor word pairs such as APCH RWY (approach and runway) since they are so common in the ASRS database. Notice, however, that such generic word pairs are not eliminated, just devalued. The weighting favors word pairs that often share the same contexts in the Cali documents, but only rarely do so in the ASRS database. For example, the word pair TERRAIN CALI is exceedingly rare in the ASRS database, but prominent in the Cali documents, so it gains prominence.

If a pair of words is never present, proximal, or sufficiently proximal, then it falls out of the query model. For example, the word pair "Civil Aeronautica" is very prominent in the Cali documents, but never occurs in the ASRS database, so it falls out of the query model. The point at which occurring word pairs fall out of the model depends on the resolution of the document models. A single occurrence of a word pair is included in the initial model of the Cali documents if the two words are separated by no more than 12 other words. This is more than sufficient resolution for modeling the text.

The method of favoring certain co-occurrences is, by itself, somewhat brittle since even marginally important word pairs from the Cali documents can appear to be very important in the query if they are very rare, but present, in the ASRS database. To adjust for this, the relational metric value associated with each word pair is also multiplied by the frequencies of those words in the Cali documents. Thus, word pairs in the query model are favored if each of the words is important in the Cali documents, if the word pairs are often found in the same contexts in the Cali documents, and if they are rarely found together in the ASRS database.

There remains an effect of "out-of-domain" vocabulary, which was not addressed in this study. This is a problem in which words such as "accident," which are common in the Cali documents, are given excessive importance due to their rarity in the ASRS database. This problem could have been addressed, but it would have required manual tuning of the models. While one of the strengths of QUORUM is that its models are fully accessible and finely tunable, it was decided that, for the sake of this exercise, it would be better only to use methods that can be applied with little or no human intervention. Fine-tuning is addressed in more detail in the discussion section.

Modeling the ASRS incident narratives—QUORUM was used to model each of the 67820 ASRS incident narratives, producing 67820 models. In modeling each of the narratives, QUORUM generated lists of word pairs that are often found in close proximity in the text. For each word pair, a proximity-weighted co-occurrence metric was computed. This metric indicates the tendency of the two words to be found in the same context. For this study, each model was limited to 100 word pairs and their associated relational metric values, that is, 100 QUORUM

relations. Thus, the 67820 narratives were modeled as 6,782,000 QUORUM relations. Figure 2 shows an example of one of the narratives, and table 2 shows a QUORUM model of that narrative.

As usual, the vocabulary of the ASRS narratives was standardized slightly for consistency. Such standardization is appropriate, though not strictly necessary, for all QUORUM-based processing of the ASRS database. It is only done during the modeling phase, and does not have any effect on the reports in the database. Examples of this standardization include mapping references to "F/O" (first officer) to "FO", and mapping a variety of references to various makes and models of aircraft to single representations. For example, "Boeing 757", "B-757", "B757", and a variety of other forms were mapped to "B757". In addition, some word pairs that function as units were linked, such as FLT_CREW, SPD_BRAKE, and ACR_X.

It is possible for a particular pair of words to be present within the same narrative, and yet their degree of co-occurrence could be too small for the word pair to be included in the model. Since each narrative, whether long or short, was limited to 100 QUORUM relations for this study, the minimum resolution of the model varies from narrative to narrative. Given the average number of words in a narrative of 219 and a context window of ±20 words, the minimum relational metric value is typically around 19. This means that a single occurrence of a word pair in a narrative will appear in the model if the two words are immediately adjacent to each other. This is probably excessive resolution. Given the maximum word count of 1479 and a context window of ±20 words, the minimum relational metric value is typically around 47. This means that two words would have to appear in close proximity (though not necessarily immediately adjacent) 3 or more times before being included in the model. If greater resolution is required, longer narratives could be modeled using more relations, in order to bring the minimum relational metric value to a lower value such as 19.

Retrieving incident narratives— In order to find the ASRS incident narratives that are most relevant to the Cali accident, the Cali query model was compared with each of the 67820 narrative models to produce a relevance-ranking value for each narrative. The method is described in appendix 1. The narratives with the 100 highest relevance-ranking values were selected for use in the study.

To compare a query model and a narrative model, their intersection is found, producing an intersection model. The intersection model represents features of the narrative that are relevant to the Cali accident. The intersection model contains word pairs that appear in both the query model and the narrative model. For example, table 2 shows a narrative model in which word pairs that are also in the Cali query model are highlighted in bold italics. So, for example, since there is a relation in the query model that contains the words APCH (approach) and CHART, as well as a relation in the narrative model containing the same words, the word pair APCH CHART (or CHART APCH, since order doesn't matter in this situation) is included among the word pairs in the intersection model.

The relational metric value (RMV) associated with each word pair of the intersection model is the product of the RMV in the query model and the RMV in the narrative model. For example, the word pair APCH CHART has an RMV of 277 in the query model (table 1) and 67 in the narrative model (table 2) to produce an RMV of 18559 in the intersection model (table 3). Table 3 also shows the other relations of the intersection model for narrative 310130.

In addition to an intersection model, table 3 also shows an example of how the relevance-ranking value (RRV) of a narrative is derived from its intersection model. Three factors are taken into consideration. The first factor is the sum of the weights (RMVs) of the intersection relations. This is a measure of the prominence in the Cali document and the prominence in the narrative. If this factor is high, then one or several elements of the incident are prominent in the Cali accident. The second factor is the fraction of the narrative model that intersects with the query model. This reflects the extent to which the commonalities of the incident and the Cali accident are central to the incident. Since this was found to favor short narratives, a third factor (the length factor) favors longer reports by multiplying by the number of words in the narrative, divided by the largest likely number of words.

The product of these three factors, the relevance-ranking value (RRV), was calculated for each of the 67820 narratives. The 100 narratives having the largest RRVs were collected for use in this study.

There is a simpler, but more abstract way to describe the calculation of the relevance-ranking value (RRV). That is, if the query model and the narrative models are considered to be vectors, then an RRV consists of the inner product of the query vector and a narrative vector, multiplied by the fraction-of-intersection factor and the length factor.

An unused, but possibly beneficial scale factor is the fraction of the query model that intersects the narrative model. This could supplement the combined weights of the intersection relations by further reflecting the extent to which the commonalities of the incident and the Cali accident are central to the accident.

For the sake of comparison, another 100 incident narratives were randomly selected from the database. This is useful because it is not known how many incidents in the ASRS database are relevant to the Cali accident. If the database were dedicated to Cali-like incidents (which it is not) then even a random collection of narratives would contain a large fraction of relevant reports. On the other hand, it might be that only a few reports are relevant to Cali. Without some idea of the number of relevant reports in the database, it would be difficult to interpret QUORUM's ability to find the most relevant reports. The proportion of relevant narratives among the randomly selected narratives is an estimate of the proportion of relevant narratives in the database. By comparing the analysts' ratings of the random collection with their ratings of the QUORUM-selected collection, it is possible to see if QUORUM performed any better than chance.

The order of the 200 incident narratives was randomized, and the narratives were printed and bound. With generous inter-line spacing to ease reading, the collection filled 141 pages. One copy was provided to each analyst.

Rating by ASRS analysts— The three analysts each read the Cali documents as their schedules permitted. They then participated in a one hour brainstorming meeting to discuss among themselves the diversity of issues raised by the documents. The analysts then read the 200 narratives and rated their relevance, as their schedules permitted. Their instructions are shown in appendix 2, figure 1. A sample page from the bound book of narratives is shown in appendix 2, figure 2.

For each narrative, the analysts responded to six assertions of relevance:

A) In some ways, the context of this incident is similar to the context of the Cali accident.

B) Some of the events of this incident are similar to some of the events of the Cali accident.

C) Some of the problems of this incident are similar to some of the problems of the Cali accident.

D) Some of the human factors of this incident are similar to some of the human factors of the Cali accident.

E) Some of the causes of this incident are similar to some of the causes of the Cali accident.

F) In some ways, this incident is relevant to the Cali accident.

The purpose of the multiple statements was to assert relevance in a number of familiar and operationally useful ways. Specifically, the first five statements assert various aspects of relevance without using the word "relevance," and the last statement asserts relevance directly without specifying what aspect of relevance is involved.

The assertions refer to six factors of relevance: context, events, problems, human factors, causes, and one or more unspecified factors. That is, they refer to six kinds of relevance, the last of which is unspecified. The degree of orthogonality of these factors (the extent of their conceptual independence) is not at issue. Further, it is not required that any particular incident have multiple factors of relevance in order to be considered relevant. Since QUORUM makes no claim to detect any particular kind of relevance, any kind of relevance is acceptable. Accordingly, if the incident is relevant in any way, it is considered to be relevant.

This breakdown of kinds of relevance, however, does allow the specific nature of the relevance to be reviewed. This is especially useful because causal relevance is of particular interest to investigators of accidents and incidents. If QUORUM found incidents having only contextual relevance but no other kinds of relevance, it would have limited practical value. The use of multiple assertions of relevance allows a review of this aspect of QUORUM's performance.

For each statement, the analysts selected from among seven responses:

1) strongly disagree
2) disagree
3) somewhat disagree
4) undecided
5) somewhat agree
6) agree
7) strongly agree

The essential purpose of the responses was to see whether the analysts rated the narratives as relevant or irrelevant. Thus, a rating of 5, 6, or 7 indicates a rating of "relevant," while a rating of 1, 2, or 3 indicates a rating of "irrelevant."

Finding the extent to which the analysts agreed with the assertions of relevance was a secondary goal. By having these levels of agreement, it is possible to gain

insight into the strength of analysts' opinions that incidents are relevant and which narratives are considered to be the most relevant.

The analysts used printed response forms to record their ratings. A sample page from the response form booklet is shown in appendix 2, figure 3.

As an example of the resulting data, the ratings of incident narrative 310130 are shown in table 4.

Results of the study

The results of this study indicate that QUORUM successfully retrieved a large proportion of incidents that were judged to be relevant to the Cali accident. That is, QUORUM relevance-ranked 67820 incident narratives from the ASRS database, and the top 100 of these were judged to contain a large proportion of relevant incidents. Specifically, eighty-four incidents were rated by one or more of the analysts as relevant to the Cali accident. Each of the analysts rated nearly two-thirds of the QUORUM's top 100 incidents as relevant to the Cali accident.

The results in the following sections are presented from a variety of viewpoints. First, the ratings by each analyst are shown, comparing the proportion of relevant incidents in the QUORUM collection to that in the random collection. Next, the ratings of each of the six assertions of relevance are shown, indicating the proportion of incidents rated as relevant to the context, events, problems, human factors, causes, and unspecified factors of the Cali accident. Following this, the degree of relevance of the QUORUM collection is compared with that of the random collection. This is based on the number of assertions of relevance to which the analysts agreed, for each incident.

Next, the strength of analysts' opinions is presented, based on the seven levels of agreement the analysts used in rating each narrative. These data are also used to sort the collections of incidents on relevance.

Several aggregations of the data are also shown, including a comparison of the mean relevance ratings of the QUORUM collection and the random collection, a measure of the consistency of ratings among the six assertions of relevance, and correlations among the ratings of the analysts and between the ratings of the analysts and QUORUM.

These various viewpoints indicate that QUORUM successfully retrieved a large proportion of incidents that are relevant to the Cali accident. This shows that a QUORUM-derived query model based on accident reports can be used with high precision to retrieve relevant incident reports. The results also indicate that QUORUM performed significantly better than chance.

In addition, the results indicate that the ratings among the analysts, and between QUORUM and the analysts, were consistent, though not identical. The issue of differences of opinion among the analysts, and between the analysts and QUORUM, is addressed in the discussion section. The discussion section also includes an outline of the operational topics contained in the relevant incidents selected by QUORUM. These topics clearly have a bearing on the prevention of future accidents.

(Note: References to analysts by number, such as "analyst 1", are unrelated to the order that the analysts are listed in the method section, "Analysts.")

Incidents rated relevant by each analyst

The results indicate that each of the analysts rated a large proportion of the QUORUM-selected incident narratives as relevant to the Cali accident. Each analyst found that approximately two-thirds of the QUORUM-selected narratives are relevant, compared with approximately one quarter of the randomly selected incidents (figure 3). Specifically, figure 3 shows that analyst 1 found 63 of 100 QUORUM-selected narratives to be relevant, compared with only 24 of 100 randomly selected narratives. Similarly, analyst 2 found 71 of 100 QUORUM-selected narratives to be relevant, compared with only 23 of 100 randomly selected narratives. Further, analyst 3 found 70 of 100 QUORUM-selected narratives to be relevant, compared with only 19 of 100 randomly selected narratives.

Incidents rated relevant to each factor

Figure 4 shows that the analysts rated a large proportion of the incident narratives in the QUORUM collection as relevant to the context, events, problems, human factors, causes, and unspecified factors of the Cali accident. Seventy of 100 QUORUM-selected narratives were rated as relevant to the context of the Cali accident by one or more of the three analysts. Similarly, seventy of 100 narratives were rated as relevant to events of the accident, seventy-four of 100 narratives were rated as relevant to problems of the Cali accident, and 67 of 100 narratives were rated as relevant to human factors of the accident. While QUORUM is not designed to detect any particular kind of relevance, it is interesting to note that 54 of the 100 QUORUM-selected narratives were rated as causally relevant. Causal relevance is a stringent criterion, yet over half the narratives QUORUM rated as relevant were rated by the analysts as causally

relevant. The analysts rated 61 narratives as relevant to unspecified factors of the Cali accident.

By comparison, figure 5 shows that few narratives in the random collection were rated as relevant to the context, events, problems, human factors, causes, or unspecified factors of the Cali accident. The analysts rated 10 of 100 randomly selected narratives as relevant to the context of the Cali accident, and 19 of 100 as relevant to events of the accident. They rated 23 of 100 narratives as relevant to problems of the Cali accident, and 26 of 100 narratives as relevant to human factors of the accident. The analysts rated 14 of 100 narratives as relevant to causes of the Cali accident, and 5 of 100 as relevant to unspecified factors.

In figures 4 and 5, a narrative is counted as relevant if at least one of the analysts agreed to the corresponding assertion of relevance. For example, the pie chart in figure 4 labeled "Events" shows 75 relevant narratives because for each of 75 narratives, at least one of the analysts agreed with the statement: "Some of the events of this incident are similar to some of the events of the Cali accident." This approach to scoring is intended to reflect the expectation that each of the analysts bases his judgments of relevance on experiences, expertise, and insights that do not necessarily intersect with those of the other analysts. In addition, there is evidence that when analysts disagree among themselves about the presence of relevant factors, the analyst denying that presence overlooked relevant factors. This issue is explored in the discussion section in "Disagreements among analysts."

Consensus among analysts

The analysts did not always agree on which incidents are relevant. As shown in figure 6, all three analysts rated 48 of 100 QUORUM-selected incidents as relevant, compared with only 9 of the randomly selected incidents. At least two of three analysts rated 72 of 100 QUORUM-selected narratives as relevant, compared with only 16 of 100 randomly selected narratives. At least one of three analysts rated 84 of 100 QUORUM-selected narratives as relevant, compared with 41 of 100 randomly selected narratives.

Whether rating QUORUM-selected incidents or randomly selected ones, the analysts agreed among themselves regarding the relevance of about two-thirds of the incidents. The pie chart on the left in figure 6 shows that 48 of 100 QUORUM-selected incidents were rated as relevant by all three analysts, and 16 of 100 were not rated as relevant by any of the three analysts, for a total of 64 unanimous ratings. In comparison, 36 of the QUORUM-selected incidents were rated as relevant by one or two of the analysts but not by the other analyst(s). Similarly, the pie chart on the right in figure 6 shows that 9 of 100 randomly selected incidents were rated as relevant by all three analysts, and 59 of 100 were not rated as relevant by any of the three analysts, for a total of 68 unanimous ratings. In comparison, 32 of 100 randomly selected incidents were rated as relevant by one or two of the analysts and not by the other analyst(s).

Disagreements among the analysts, and some incidents about which they disagree, are reviewed in more detail in the discussion section in "Disagreements among analysts."

Degree of relevance of the collections

If a collection contains a large proportion of incident narratives that are highly relevant, then that collection is itself highly relevant. One measure of the degree of relevance of a particular narrative is the number of assertions of relevance to which one or more analysts agree. For example, if an analyst agrees with one assertion of relevance, it would indicate that the narrative is relevant, while agreement with two assertions of relevance would indicate that the narrative has a higher degree of relevance. Agreement with six assertions of relevance would indicate a very high degree of relevance. Thus, to gain insight into the degree of relevance of a collection of incidents, it is useful to see the number of narratives that are relevant to a particular number of assertions of relevance. Accordingly, figure 7 shows the number of incident narratives rated as relevant to the Cali accident in response to N of six assertions of relevance, for values of N ranging from 6 to 1.

The two pie charts of figure 7 show that the analysts rated many of the QUORUM-selected incidents as highly relevant, while few of the randomly selected incidents were rated as highly relevant. Thus, the QUORUM collection has a high degree of relevance, while the random collection has a low degree of relevance, as indicated by the following observations. In rating 45 of the 100 QUORUM-selected incidents, each of the six assertions of relevance was agreed to by one or more of the analysts. That is, 45 of the 100 QUORUM-selected incidents were judged to be relevant to the context, events, problems, human factors, causes, and unspecified factors of the Cali accident. In comparison, only 3 of the 100 randomly selected incidents were judged to have all six relevance factors. Twelve of the 100 QUORUM-

selected incidents were judged to have exactly five of the relevance factors, so a total of fifty-seven of 100 QUORUM-selected incidents were judged to have at least 5 of the relevance factors. In comparison, only 5 of the 100 randomly selected incidents were similarly judged. Nine of the 100 QUORUM-selected incidents were judged to have exactly 4 of the relevance factors, so a total of 66 of 100 QUORUM-selected incidents were judged to have at least 4 of the relevance factors. In comparison, only 8 of the 100 randomly selected incidents were similarly judged. Six of the 100 QUORUM-selected incidents were judged to have exactly 3 of the relevance factors, so a total of 72 of the 100 QUORUM-selected incidents were judged to have at least 3 of the relevance factors. In comparison, only 16 of the 100 randomly selected incidents were similarly judged. Five of the 100 QUORUM-selected incidents were judged to have exactly 2 of the relevance factors, so a total of 77 of the 100 QUORUM-selected incidents were judged to have at least 2 of the relevance factors. In comparison, only 24 of the 100 randomly selected incidents were similarly judged.

Finally, seven of the 100 QUORUM-selected incidents were judged to have exactly one of the relevance factors, so a total of 84 of the 100 QUORUM-selected incidents were judged to have at least one of the relevance factors. In comparison, only 41 of the 100 randomly selected incidents were similarly judged. Thus, 84 of the 100 QUORUM-selected incidents were judged to be relevant to the context, events, problems, human factors, causes, and/or unspecified factors of the Cali accident.

Taken together, these results indicate that the QUORUM collection has a high degree of relevance, while the random collection has a low degree of relevance.

Strength of analysts' opinions

In responding to each of the six assertions of relevance, the analysts varied in their level of agreement or disagreement. This was captured by the 7-level response scale shown in the section, "Rating by ASRS analysts." So, for example, if the analysts agreed with the assertion that "Some of the human factors of this incident are similar to some of the human factors of the Cali accident," they could "somewhat agree," "agree," or "strongly agree." If they disagreed with that assertion, they could "somewhat disagree," "disagree," or "strongly disagree." They were also free to declare that they were "undecided."

In rating the random collection of 100 incidents, each analyst provided, in effect, his estimate of the number of incidents likely to be found at each level of agreement in any random sample of 100 incidents. In rating the QUORUM collection of 100 incidents, each analyst specified how many incidents at each level were actually retrieved by QUORUM. For example, regarding the level of agreement "strongly agree," the three pie charts on the right in figure 8 show that one is unlikely to find any incidents among a random collection of 100 incidents about which the analysts would "strongly agree" with an assertion of relevance. In contrast, the three pie charts on the left in figure 8 show that the analysts "strongly agreed" that 4 to 15 incidents in the QUORUM collection are relevant to the Cali accident. Here are the details. Analyst 1 did not "strongly agree" that any of the incidents in the random collection are relevant to the Cali accident, but "strongly agreed" that 4 of the QUORUM collection are relevant. Similarly, analyst 2 did not "strongly agree" that any of the random incidents are relevant, but "strongly agreed" that 12 of the QUORUM collection are relevant. Finally, analyst 3 "strongly agreed" that 1 incident from the random collection is relevant, but "strongly agreed" that 15 of the QUORUM collection are relevant. Thus, QUORUM performed much better than chance.

Similarly, regarding the level of agreement "agree," the three pie charts on the right in figure 8 show that one is unlikely to find more than a few incidents, among a random collection of 100 incidents, about which the analysts would "agree" with an assertion of relevance. In contrast, the three pie charts on the left in figure 8 show that the analysts "agree" that 20 to 31 of the incidents in the QUORUM collection are relevant to the Cali accident. Here are the details. Analyst 1 "agreed" that 1 of the incidents in the random collection is relevant to the Cali accident, but "agreed" that 24 of the QUORUM collection are relevant. Similarly, analyst 2 "agreed" that 1 of the random incidents is relevant, but "agreed" that 31 of the QUORUM collection are relevant. Finally, analyst 3 "agreed" that 4 incidents from the random collection are relevant, but "agreed" that 20 of the QUORUM collection are relevant. Again, QUORUM performed much better than chance.

Each of the remaining levels can be interpreted in a similar fashion. This analysis leads to the conclusion that the analysts more strongly agreed that the QUORUM-selected incidents, rather than the randomly selected ones, are relevant to the Cali accident. Further, the analysts more strongly disagreed that the randomly selected incidents are relevant.

Appendix 3 presents the data in a different way. It uses the strength-of-opinion data to sort the incidents according to relevance. In appendix 3, table 1, all 100 QUORUM-selected incident narratives are shown sorted in order of their ratings by the analysts. In appendix 3, table 2, all 100 randomly selected incident narratives are shown sorted in order of their ratings by the analysts.

While there are several useful ways to sort these tables on relevance, the method that was used sorts on the number of scores at each level of agreement. Thus, if all three analysts strongly agreed with any of the assertions of relevance for a particular incident, then that incident is considered to be more relevant than one for which only two analysts strongly agreed with assertions of relevance. Further, if a single analyst strongly agrees that an incident is relevant, that incident is ranked as more relevant than one in which all three analysts merely agreed, but none agreed strongly. A review of the narratives themselves suggests that this sorting method produces a list that is reasonably well-sorted on degree of relevance.

In figure 8 and in appendix 3, each analyst's highest rating across the six assertions of relevance is used to characterize each narrative because an agreement with any assertion of relevance is an acknowledgment that the narrative has some kind of relevance. For example, if an analyst "strongly agrees" with the assertion that the human factors of an incident are relevant to the Cali accident, but disagrees that there are other similarities, it remains true that the analyst "strongly agrees" that the narrative has relevance to the Cali accident.

The significance of QUORUM's performance

A simple test was conducted to investigate the significance of the difference between the estimated mean relevance rating of the 67820 incident narratives from the ASRS database, and the mean relevance rating of the collection of QUORUM-selected incident narratives. The mean rating of the collection of randomly selected incidents was used as an estimate of the mean relevance rating of the ASRS database. The hypothesis being tested was that the mean relevance rating of incidents in the collection of QUORUM-selected incidents is significantly higher than the estimated mean relevance rating of the 67820 incidents from the ASRS database. If true, this would indicate that QUORUM had performed significantly better than chance.

One rating was used to represent each incident narrative: the highest rating across response statements and analysts. This rating indicates whether any of the analysts judged the incident to be relevant in any of the six ways (context, events, problems, human factors, causes, or unspecified relevance).

The mean rating of the QUORUM collection, averaged across narratives, is 5.40. The mean rating of the random collection, averaged across narratives, is 3.61.

Based on the ratings, the test statistic t (Kanji, 1993, pg. 27) is equal to 13.275. Comparing this value with Student's t distribution with 99 degrees of freedom (Snedecor and Cochran, 1989, pg. 466), the probability of achieving a value of this magnitude is less than 0.001. That is, there is less than 1 chance in 1000 that the mean rating of QUORUM's collection could have been achieved by random sampling.

Thus, the mean rating of incidents in the collection of QUORUM-selected incidents is significantly higher than the estimated mean rating of the 67820 incidents from the ASRS database. Such performance is very unlikely to have been achieved by chance.

Consistency among the assertions of relevance

Cronbach's alpha, a measure of the internal consistency of a collection of response statements (Spector, 1992), was used to measure the consistency among the six assertions of relevance. Cronbach's alpha measures how well the statements reflect a common, underlying construct. A value of 0.7 or greater is considered to be an indication of internal consistency.

Based on the analysts' ratings of the 200 narratives, Cronbach's alpha is 0.962, indicating that responses to the six assertions of relevance are highly intercorrelated, and that the responses to the individual statements reflect responses to a common, underlying construct.

Cronbach's alpha does not guarantee that the meaning of the common, underlying construct is the same as the intended meaning. That meaning is carried by the wording of the assertions, and must be interpreted by the analysts.

The purpose of the multiple statements was to assert relevance in a number of familiar and operationally useful ways. Specifically, the first five statements assert various aspects of relevance without using the word "relevance," and the last statement asserts relevance directly without specifying what aspect of relevance is involved. The wording of the assertions centers on two concepts. The first concept is similarity between features of an incident and features of an accident. The second concept is the relevance of an incident to an accident. Cronbach's alpha indicates that the statements based on these concepts elicited consistent responses from the analysts. The high value of Cronbach's alpha indicates that, as intended, the various questions did address a single underlying

concept, which, in this case, could be called either feature similarity or relevance.

While the intended meaning of the assertions is clear, the analysts' ratings show that the assertions measure what was intended. A reading of the incidents rated highest by the analysts (e.g., the 10 incidents in appendix 4) indicates that they are highly relevant to the Cali accident. Those rated lowest generally have little or no relevance. This is further evidence that the six assertions of relevance do, in fact, measure analyst's opinions of relevance.

Correlations

The broad pattern of agreement among the analysts, and between the analysts and QUORUM, can be seen by looking at the correlations among the ratings. Since any kind of relevance is of interest, the maximum rating across assertions of relevance is used to calculate the correlations reported here. Further, the correlations are based on the ratings of all 200 narratives. Given the 198 degrees of freedom, these observed values of r, the correlation coefficient, are all statistically significant at the 1% level (Snedecor and Cochran, 1989, pg. 473).

X	Y	r
analyst 2	analyst 3	0.706
analyst 1	analyst 2	0.616
analyst 1	analyst 3	0.573
QUORUM	analyst 3	0.590
QUORUM	analyst 2	0.560
QUORUM	analyst 1	0.489

Among the analysts, the ratings of analysts 2 and 3 are most correlated, while the ratings of analysts 1 and 3 are least correlated. QUORUM's ratings are most correlated with those of analyst 3, while QUORUM's ratings are least correlated with those of analyst 1. It is interesting to note that QUORUM's ratings are more correlated with the ratings of analyst 3 (r=0.590) than the ratings of analyst 1 are correlated with the ratings of analyst 3 (r=0.573). This suggests that QUORUM's ratings are worthy of comparison with those of human raters.

Discussion

The results indicate that the analysts rated many of the QUORUM-selected incidents as relevant, and few of the randomly selected incidents as relevant; that QUORUM performs significantly better than chance; and that QUORUM can retrieve a large proportion of relevant incident reports based on analysis of accident reports.

Still, the analysts did not always agree regarding the relevance of particular incident narratives. Whether rating QUORUM-selected incidents or randomly selected ones, the analysts agreed among themselves regarding the relevance of about two-thirds of the incidents. This issue is discussed in the section, "Disagreements among analysts."

From the viewpoint of commercial aviation operations, it is useful to examine the nature of the incidents retrieved by QUORUM. Even though many of the incidents were rated as relevant, which of the important Cali-related factors do they contain? Are they all "controlled flight toward terrain" (CFTT) incidents, or are other factors involved? The section "Prominent factors among the relevant narratives" examines these questions.

Finally, QUORUM was occasionally misled by the presence of words such as "accident," "FAA," "safety," and "civil." This highlights a particular concern when using accident reports to find incidents, as discussed in the section, "Improving QUORUM's performance."

Disagreements among analysts

It was not expected that the three analysts would always agree in their opinions. This is particularly true because the analysts in this study came from three different roles within the domain of commercial aviation. One analyst was a pilot for a major commercial airline, another was a corporate pilot, while the third was an air traffic controller. While they all shared the same aviation environment, their particular roles were complementary. Thus, while these professionals share a certain amount of expertise and experience, much of their domain knowledge and insight is unique to each of them. As a result, one would not expect the three analysts to have identical interpretations of the Cali accident. Neither would one expect that the analysts would have identical appreciation of the relevant factors of every incident.

Given this expected diversity of insight and opinion, care must be taken when combining analysts' ratings. In figures 4 and 5, for example, a narrative is counted as relevant if at least one of the analysts agreed with each of the assertions of relevance. This approach to scoring is intended to reflect the expectation that each of the analysts bases his judgments of relevance on experiences, expertise, and insights that do not necessarily intersect with those of the other analysts.

This approach to scoring also reflects the fact that there is evidence, examples of which are shown below, that when analysts disagree among themselves about the presence of relevant factors, the analyst denying that presence seems to have overlooked

relevant factors or perhaps made an error in marking the rating form. (It is important to note in this context that the tasks involved in this study are quite different from the tasks usually performed by ASRS analysts. In no way does this study have anything to say about their performance of ASRS tasks. It was not designed to investigate such issues.)

The rating of incident narrative 310228 is an example in which analysts had diametrically opposite opinions. In rating that incident, analysts 2 and 3 either agree or strongly agree that the narrative is relevant to the context, events, problems, human factors, causes, or unspecified factors of the Cali accident, yet analyst 1 disagrees or somewhat disagrees that any of the factors are relevant. A review of the narrative of incident 310228 (appendix 5, figure 1) suggests that analysts 2 and 3 are correct, while analyst 1 has apparently overlooked relevant factors. Just as at Cali, the incident involved a VOR/DME approach, there was miscommunication between the crew and the controller, the crew was confused about the approach, the flight was off course, and name confusion was a central factor. In fact, just as the Cali accident involved same-letter identifier confusion about a navigation fix (Rozo's R vs. Romeo's R), this incident involved sound-alike name confusion about a navigation fix (Beeje vs. Meach). One must conclude that analyst 1 is mistaken in denying the presence of any relevant factors.

In another example, in rating the incident narrative 140711, analysts 1 and 3 either agree or somewhat agree that the narrative is relevant to the context, events, problems, human factors, causes, or unspecified factors of the Cali accident, yet analyst 2 strongly disagrees that any of the factors are relevant. A review of the narrative of incident 140711 (appendix 5, figure 2) suggests that analysts 1 and 3 are correct, while analyst 2 seems to have overlooked relevant factors. The incident took place in Colombian airspace and involved one of the ATC facilities, Barranquilla Center, that was involved in the Cali accident. So, the context, at least, is nearly identical, not just similar. Just as in the Cali incident, the flight was cleared direct to the Tulua VOR. So, one of the events of the incident is identical, not just similar, to the Cali accident. A problem of the incident involved the quality, or perceived quality, of Colombian air traffic control, and this problem is highly relevant to the Cali accident. The performance of the air traffic controller is a human factors issue in both the incident and the Cali accident. In this incident, the direct clearance to the Tulua VOR, the performance of the Colombian controller, and the quality of Colombian ATC are, in some ways, similar to the causes of the Cali accident. Given all of these similar factors, it is easy to see why analysts 1 and 3 rated the incident as relevant, and hard to see why analyst 2 did not.

In yet another example, in rating incident narrative 153355, analyst 1 agrees or somewhat agrees that the incident is relevant to the Cali accident. Analyst 2 somewhat agrees or is undecided. Analyst 3, however, somewhat disagrees, disagrees, or strongly disagrees that the incident is relevant. A review of the incident (appendix 5, figure 3) indicates that it occurred during approach, it involved difficulty with the FMS and over-reliance on the FMS, and, even more relevant to the Cali accident, the crew was unsure of their position and the flight was off course. It appears that in rating this incident, analyst 3 overlooked relevant factors.

As a final example, incident 355364 (appendix 5, figure 4) was rated as irrelevant by analysts 1 and 3, while analyst 2 only somewhat agreed with one of the six assertions of relevance. In this case, only analyst 2 is correct. First, the incident and the Cali accident both occurred in the context of the approach phase of flight. More important, the incident involved two events that also occurred in the Cali accident. First, the crew received a GPWS (ground proximity warning system) warning. Second, the crew performed an escape maneuver. Only analyst 2 agreed with the statement, "Some of the events of this incident are similar to some of the events of the Cali accident." Analyst 1 flatly disagreed with this statement, and analyst 3 somewhat disagreed. Clearly, the GPWS warning and the escape maneuver were events that are similar to those in the Cali accident. So analyst 1 and 3 must have overlooked these events or perhaps misunderstood what is meant by "events." Or perhaps analysts 1 and 3 were expressing an opinion that nothing can be learned from this narrative that would have an influence on preventing future accidents like the one at Cali. If so, they failed to follow instructions. Besides, previous experiences with false GPWS warnings can be a factor in accidents involving controlled flight into terrain (Majikas, 1995). None of the analysts agreed with the statement, "In some ways, the context of this incident is similar to the context of the Cali accident." Apparently, the fact that this incident and the Cali accident happened during the approach phase was insufficiently important for the analysts to consider the contexts to be similar.

These examples are typical of the cases in which the analysts disagreed among themselves regarding the relevance of particular narratives. Review of the ratings of these and other similar cases indicates that when relevant

factors are present in an incident narrative, they are rarely overlooked by all three analysts.

Prominent factors among the relevant narratives

One might assume that all incidents related to a "controlled flight into terrain" (CFIT) accident would be "controlled flight toward terrain" (CFTT) incidents. A review of the Cali accident, however, suggests that many other factors can play a role, as listed in the introduction of this paper (see section, "The Cali accident," on pg. 1). A review of the 84 QUORUM-selected incidents that the analysts rated as relevant to the Cali accident shows that the incidents contain a variety of similar factors, including over-reliance on automation, confusion during descent/approach, and operations in foreign airspace, as well as CFTT and GPWS (ground proximity warning system) alarms.

The following outline shows the topical categories and subcategories of the 84 incident narratives that were rated relevant by QUORUM and one or more of the analysts. This outline is derived from the factors of the Cali accident listed on page 2 of this paper. The number in parentheses at the end of each line is the number of incidents in that category or subcategory. The numbers sum to 91 because five of the incidents appear in two places, and another one appears in three places. Because of these and other cases of categorical overlap, the numbers in the headings should not be over-interpreted. (As used here, the term "automation" refers to the FMS (flight management system) or other components of the automated flight systems that are used to operate the aircraft.)

1. Over-reliance on automation, and other problems with use of automation (37)
1.1. Over-reliance on automation (36)
1.1.1. Automation turns aircraft off course (5)
1.1.2. Loss of data when other data are entered (5)
1.1.3. Distracted by automation (7)
1.1.4. Name confusion using automation (4)
1.1.5. Automation data entry error or data error (6)
1.1.6. Other problems getting automation to work as desired (4)
1.1.7. Miscellaneous over-reliance on automation (5)
1.2. Other automation-related problems (1)

2. Confusion, changes, and other problems during descent/approach (29)
2.1. Last minute approach/runway change leads to significant confusion (3)
2.2. Other confusion during descent/approach (11)
2.2.1. Name confusion (5)
2.2.2. Confusion regarding charts (4)
2.2.3. Confusion due to use of wrong data (2)
2.3. Forgot speed brakes (2)
2.4. Other problems with changes late in descent/approach (4)
2.5. Miscellaneous problems during descent/approach (9)

3. Terrain avoidance (19)
3.1. GPWS alarms (15)
3.1.1. Complacency, loss of situational awareness, slow reaction (5)
3.1.2. Miscellaneous GPWS alarms (10)
3.2. Other terrain-related incidents (4)

4. Problems with operations in foreign airspace (6)
4.1. Problems with operations in Latin America (4)
4.2. Problems with operations in other foreign locations (2)

Appendix 6 shows excerpts of all 84 relevant narratives, organized according to the outline above. The outline and excerpts demonstrate that QUORUM-selected incidents contain a wide variety of the factors that are relevant to the Cali accident, with emphasis on some of the most important factors. Thus, many of the links of the chain of factors found in the Cali accident are found scattered among the incidents. Some incidents contain several of these factors, while others contain only one of them.

Appendix 7 shows excerpts of all 16 of the narratives that were rated relevant by QUORUM but irrelevant by all three analysts. Review of these excerpts indicates that 5 of these incidents are clearly irrelevant, 6 are vaguely relevant, and 5 are relevant.

Taken together, appendices 6 and 7 contain excerpts of all 100 of the incidents that QUORUM rated as being the most relevant to the Cali accident of the 67820 incidents from the ASRS database.

Improving QUORUM's performance

QUORUM models can be refined by deleting relations that do not contain word pairs of interest. This is discussed in great detail in McGreevy (1997). While automatically generated query models can be very effective, as demonstrated by the results of this study, they can be improved by weeding out relations that are not of interest. Specifically, the number of QUORUM-selected incidents that are not relevant can be reduced by eliminating from the query model word pairs that are not operationally oriented, such as BELIEVES SAFETY.

A typical sentence containing "believes" and "safety" from the accident reports is:

> "Therefore, the Safety Board believes that the FAA should require that all approach and navigation charts graphically present terrain information."

Because sentences like this are common in the documents used to generate the query model, word pairs like BELIEVES SAFETY appear to be important. They are, in fact, important, but only from the point of view of accident investigation and safety recommendations, not from the point of view of the operational factors of the accident. (In contrast, the word pair "TERRAIN CHARTS" from the same sentence is operationally oriented and would be retained.) The rarity of the word pair BELIEVES SAFETY in the ASRS database magnifies the apparent importance of this word pair. This can lead to retrieval of narratives that are not really relevant. The solution is to delete this and other similar word pairs from the query model because they come from the vocabulary of accident reports and safety recommendations, not from the vocabulary of operational problems.

A further improvement can be obtained by removing words, word groups, and abbreviations that often appear in accident reports, but are not useful in identifying operational problems among incident narratives. Examples include:

- International Civil Aviation Organization (ICAO)
- National Transportation Safety Board (NTSB)
- Federal Aviation Administration (FAA)
- United States (U.S.)
- investigation
- accident
- crash
- time of impact

The deletions would be applied to the accident documents before the query model is generated. (To avoid distorting the distances measured among other words, the deleted words would be replaced with generic non-words to act as place-holders.)

Another class of words and word groups to be deleted includes those that are specific to a particular accident investigation. Among the most prominent of these terms in the Cali document are:

- Aeronautica Civil
- American Airlines
- AA
- Flight 965
- AA965

Words and word groups that are particular to the operational setting of the accident would *not* be deleted. These include, for example:

- Tulua
- Barranquilla Center
- Colombia
- Latin America

Other ASRS incidents containing these words or word groups might be relevant to the operational problems associated with the Cali accident.

A more radical idea, and perhaps a risky one, is to eliminate words that reflect an outsider's view of operations, since the core of ASRS narratives reflect an insider's vocabulary. Among these words are:

- flight crew(s)
- pilot(s)

Members of flight crews more often refer to the captain or first officer. Review of irrelevant incidents retrieved by QUORUM (see appendix 7, sections 6 and 7) suggests that elimination of these words would reduce QUORUM's false positive rate.

In summary, QUORUM models can be easily refined by removing relations that are not of interest, but such refinement sometimes requires manually picking through the model relations. This effort is not necessary, as indicated by QUORUM's success in this study using an automatically generated query model. Still, it might be worthwhile in some applications to remove words, word groups, abbreviations, and word pairs that are oriented toward accident investigation and safety recommendations rather than operational details. Once the offending material is collected, it can be reused in subsequent analyses, allowing fully automated modeling and relevance-ranking.

Related work

Using QUORUM for relevance-ranking puts it squarely in the technical domain of "information retrieval" (Frakes and Baeza-Yates, 1992). In that domain, nearly all work in relevance-ranking is based on the occurrence or frequency of words in documents (e.g., Salton, 1991), and very little of it is based on the co-occurrence of words. What co-occurrence work there is (e.g., Smadja, 1991) typically addresses analysis of word groupings such as "home run" rather than conceptual proximities and variably proximal co-occurrences, and little of it directly involves information retrieval.

Osgood (1959) pioneered the modeling of text based on conceptual (but not variably proximal) co-occurrences, but the method was not applied to information retrieval.

Recently, Hawking and Thistlewaite (1996) have been developing co-occurrence methods for information retrieval, but their methods are significantly different from QUORUM methods. For example, while QUORUM's query models are based on proximity-weighted co-occurrences among prominently occurring words in a body of text such as the Cali accident reports, Hawking and Thistlewaite base their query models on

unstructured and spontaneous generation of possibly occurring and possibly clustered words.

A proximity method for information retrieval developed by Caid and Oing (1997) is based on the premise that if two different words are frequently found very close together in text, they are likely to be in similar categories, and thus have similar meanings or usages. Caid and Oing combine a document's word-categories into a single abstract category in order to summarize the contents of the document. Querying consists of finding abstract document categories that are similar to a particular abstract document category. In contrast, the QUORUM method is based on the premise that the associative structure of a text reflects the associative structure of the domain described in the text, as indicated by the concerns of the author (or authors). Concerns that are more frequently found in closer proximity in the text are those which are more strongly associated by the author. An explicit network of these associations constitutes a model of the text and a model of the concerns of the author. Querying consists of finding networks of concerns (e.g., models of ASRS narratives) that are similar to a particular network of concerns (e.g., a model of the Cali documents).

Work related to QUORUM relevance-ranking is reviewed in McGreevy (1997). Work related to QUORUM modeling, upon which QUORUM relevance-ranking is based, is reviewed in great detail in McGreevy (1995).

Conclusion

QUORUM successfully retrieved a large proportion of incidents that are relevant to the Cali accident. Eighty-four of 100 QUORUM-selected narratives were rated as relevant to the Cali accident by one or more of the analysts. Each analyst rated approximately two-thirds of the QUORUM-selected narratives as relevant. Over two-thirds of the incidents retrieved by QUORUM were rated as relevant to the context, events, problems, or human factors of the Cali accident. Over half of the incidents were rated as relevant to the causes of the accident. Further, the QUORUM collection of incidents was significantly more relevant than the random collection. These results show that a QUORUM-derived query model based on accident reports can be used successfully to retrieve relevant incident reports.

The ratings among the analysts, and between QUORUM and the analysts, were consistent, though not identical. Whether rating QUORUM-selected incidents or randomly selected ones, the analysts agreed among themselves regarding the relevance of about two-thirds of the incidents. This is attributed to the diversity of experience among the analysts, and to occasions in which one or two of the analysts recognize relevant factors that are overlooked by the other(s). As it turns out, QUORUM's ratings are more correlated with the ratings of analyst 3 than the ratings of analyst 1 are correlated with the ratings of analyst 3, suggesting that QUORUM's ratings are worthy of comparison with those of human raters.

The QUORUM-selected incidents contain a variety of factors that are similar to those of the Cali accident, including over-reliance on automation, confusion during descent/approach, and operations in foreign airspace, as well as CFTT and GPWS (ground proximity warning system) alarms. These topics clearly have a bearing on the prevention of future accidents.

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Figures and Tables

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```
ACCESSION NUMBER  : 204756
DATE OF OCCURRENCE           : 9203
REPORTED BY                  : FLC; ; ;
PERSONS  FUNCTIONS           : FLC,FO; FLC,PIC.CAPT; ARTCC,RDR;
FLIGHT CONDITIONS            : VMC
REFERENCE FACILITY ID        : ONM
FACILITY STATE               : NM
FACILITY TYPE                : ARTCC;
FACILITY IDENTIFIER          : ZAB;
AIRCRAFT TYPE                : MLG;
ANOMALY DESCRIPTIONS         : IN-FLT ENCOUNTER/OTHER; ACFT EQUIPMENT
    PROBLEM/LESS SEVERE; ALT DEV/EXCURSION FROM ASSIGNED; NON
    ADHERENCE LEGAL RQMT/CLNC;
ANOMALY DETECTOR             : COCKPIT/FLC;
ANOMALY RESOLUTION           : FLC OVERCAME EQUIP PROBLEM; FLC
    RETURNED ACFT TO ORIGINAL CLNC OR INTENDED COURSE;
ANOMALY CONSEQUENCES         : NONE;
SITUATION REPORT SUBJECTS    : PROC OR POLICY/COMPANY; AN ACFT TYPE;
    ACFT EQUIPMENT;
NARRATIVE                    : AUTOPLT ON IN 'PERF' MODE, CRUISE
    CONDITIONS. ACFT STARTED A SLIGHT DSCNT TO ABOUT 300 FT BELOW
    ASSIGNED ALT, WHEREUPON CAPT SELECTED 'VERT SPD' MODE AND A 500
    FPM CLB. BUT ACFT STARTED TO CLB AT 2000 FPM AND WENT RIGHT
    THROUGH SELECTED ALT OF FL350 TO ABOUT 450 FT HIGH, WHEREUPON CAPT
    DISCONNECTED AUTOPLT AND RETURNED TO FL350. NO CONFLICT. I'M STILL
    NOT SURE IF THIS WAS DUE TO MOUNTAIN WAVE ACTIVITY OR AUTOPLT
    MALFUNCTION OR BOTH. CAPT ASSUMED MOUNTAIN WAVE AND INSTRUCTED ME
    TO RPT IT TO CTR. THIS PARTICULAR AUTOPLT, WHEN USED IN THE 'PERF
    CRZ' MODE (WHICH IS SOP) CONSISTENTLY DEVIATES FROM SELECTED ALT
    BY + OR - 100 TO 200 FT. THIS MAKES IT AT TIMES DIFFICULT TO
    DETERMINE IF AUTOPLT IS FUNCTIONING 'NORMALLY' OR MALFUNCTIONING
    UNTIL IT IS TOO LATE. STILL, IF WE HAD BEEN MORE AGGRESSIVE IN
    DISCONNECTING AUTOPLT SOONER AND FLYING PROPER ALT, WE MIGHT HAVE
    DIMINISHED THE ALT EXCURSION.
SYNOPSIS                     : CLR AIR TURB ASSOCIATED WITH MOUNTAIN
    WAVE ACTIVITY CREATES AN ALTDEV ALT EXCURSION.
REFERENCE FACILITY ID        : ONM
FACILITY STATE               : NM
MSL ALTITUDE                 : 34700,35450
```

Figure 1. Example incident report from the Aviation Safety Reporting System (ASRS) database. This report describes a situation involving an altitude deviation and the autopilot.

Table 1. Excerpt of QUORUM query model derived from the Cali accident report documents, containing 2436 co-occurring word pairs. The top 100 relations are shown here, along with a sampling of less important relations in the model. Word pairs with larger relational metric values (RMVs) are the more important query relations. The query model was compared with each of the 67820 incident models in the database (e.g., Table 2), and for each incident, a single relevance-ranking value was calculated (for example, see Table 3).

word 1	word 2	RMV
CALI	TERRAIN	35389
FMS	PLTS	25488
FLT_CREW	AWARENESS	22072
CALI	VOR	18281
FMS	FLT_CREW	17511
FMS	FAA	17155
ACCIDENT	TERRAIN	13275
TERRAIN	CHARTS	13131
FMS	BOARD	12754
FAA	CIVIL	12533
FMS	TRAINING	11469
TERRAIN	FAA	11355
ACCIDENT	OPS	10890
PLTS	TERRAIN	10210
FLT_CREW	TERRAIN	10032
TERRAIN	AWARENESS	10018
APCH	ACCIDENT	9999
CALI	DIRECT	9314
APCH	DISPLAYS	8616
FLT_CREW	CRITICAL	8417
ACCIDENT	CAPT	8327
SAFETY	BELIEVES	7400
CAPT	AMERICAN	7230
TERRAIN	USED	6969
FLT_CREW	VOR	6678
TERRAIN	SIT	6674
PLTS	CRM	6525
TERRAIN	SPD_BRAKES	6439
APCH	FLT_CREWS	6301
APCH	CIVIL	6100
PLTS	ACCIDENT	6074
NAV	REQUIRE	6002
FMS	COMMAND	5990
TERRAIN	PRESENT	5984
FMS	PLT	5934
CAPT	AA	5760
BELIEVES	BOARD	5332
FMS	CHART	5258
APCH	FMS	5150
ACCIDENT	FO	5038
CHARTS	BELIEVES	5007
FMS	FIXES	4719
TERRAIN	CFIT	4550
FLT_CREW	FLT_PATH	4492
VOR	TULUA	4491
FLT_CREW	ESCAPE	4489
TERRAIN	NAV	4407
CALI	COLOMBIA	4032
ACCIDENT	MIA	3992
NOT	AA	3909
TERRAIN	REQUIRE	3839
SPD_BRAKES	PERF	3822
ACCIDENT	ICAO	3781
FMS	ENVIRONMENT	3717
FMS	II	3689
CALI	ATC	3647
CALI	CLRED	3643
PLTS	PRESENT	3637
FLT_CREW	RECOGNIZE	3566
ACCIDENT	B757	3564
NOT	ICAO	3510
CTLR	CIVIL	3402
PLTS	SITUATIONAL	3373
APCH	INVESTIGATION	3347
PLTS	PROX	3299
ACCIDENT	TRAINING	3188
SPD_BRAKES	CREW	3166
ACCIDENT	CTLR	3072
TRAINING	CIVIL	3063
FMS	STATES	3034
FLT_CREW	PRESENT	3011
ACCIDENT	RTE	2989
CALI	HIGH	2979
PLT	SPD_BRAKES	2967
TERRAIN	TRAINING	2966
APCH	ROMEO	2941
FLT_CREW	BELIEVES	2883
FLT_CREW	ACTIONS	2845
FLT_CREW	SITUATIONAL	2822
FMS	INVESTIGATION	2801
ACCIDENT	NAV	2741
CHARTS	REQUIRE	2723
FMS	NDB	2704
NOT	AMERICAN	2613
SAFETY	BOARD	2587
FAA	EVALUATE	2534
SPD_BRAKES	PITCH	2534
OPS	B757	2513
SPD_BRAKES	B757	2498
APCH	FLT_CREW	2493
FLT_CREW	DECISION	2464
PLTS	LATIN	2459
TERRAIN	PATH	2446
FLT_CREW	GPWS	2441
TERRAIN	DATA	2437
PLTS	AWARENESS	2389
FMS	CONFUSING	2384
FMS	CONFUSION	2378
CIVIL	INTL	2327
FLT_CREW	MANEUVER	2325
...		
AWARENESS	SIT	1002
...		
POS	WAYPOINTS	278
APCH	CHART	277
...		
MANEUVER	PITCH	100
NDB	ENTERING	100
...		
SPD_BRAKE	LEVER	10
TERRAIN	WARNINGS	10
...		
WX	CLOUDS	1

310130
WE WERE INITIALLY GIVEN A VECTOR DIRECT TO ARSOT AND PROGRESSIVE DSCNTS TO 5000 FT. WE QUESTIONED THE CTLR REPEATEDLY ABOUT WHICH APCH WE COULD EXPECT. ATIS WAS GIVING ILS RWY 35 APCHS WITH A CIRCLE TO LAND ON RWY 11. THE WIND WAS 160 DEGS AT 14 KTS, AND WE WERE NOT VERY HAPPY WITH THAT PROSPECT. WE HAD SCATTERED TO BROKEN CLOUDS AT ABOUT 1300-1500 FT. I WAS HAVING A VERY DIFFICULT TIME UNDERSTANDING THE CTLR, AND THE FO AND SO WERE NOT DOING MUCH BETTER. THE ILS FOR RWY 11 WAS NOTAMED OTS. AT THE LAST MIN, AFTER WE WERE VECTORED DIRECT TOWARD THE OUTER LOCATOR 'OC', WE WERE CLRED FOR A 'STRAIGHT IN LNDG ON RWY 11' AND TOLD TO RPT OVER 'OC.' I HAD #1 VOR DME ON EZE AND THE FO INITIALLY SET UP HIS RADIO ON THE LOC 110.1, BUT THERE WAS NO LOC OR ANYTHING ON THAT FREQ. THE FO KEPT ASKING ME TO GET THE TYPE OF APCH AND ALT FROM THE CTLR. THE CTLR SAID TO FLY THE ALTS OF THE APCH. WE HAD BRIEFED BOTH THE ILS TO RWY 35 WITH A CIRCLE TO LAND AND THE LOC-VOR-DME RWY 11 APCH, BUT NOT A STRAIGHT IN APCH. THE ONLY STRAIGHT IN APCH WAS AN ADF LOCATOR APCH, WITH DME. OUR MINIMUM SECTOR ALT WAS 3000 FT AND WE WERE AT 5000 FT. WHEN WE WERE INSTRUCTED TO FLY THE ALTS ON THE APCH, FO (PF) SET THE ALT WINDOW TO 2150 FT WHICH WAS THE ALT FOR 10 DME ON THE 11-1 PAGE FOR A VOR APCH. MEANWHILE I WAS TRYING TO FIND AN APPROPRIATE APCH PAGE. WE SETTLED ON 11-2 CHART SINCE THE CTLR HAD CALLED THE APCH A 'STRAIGHT-IN APCH.' THE SO WAS HELPING THE FO WITH HIS CHART AND RADIO SETUP, AND WE WERE DSNDING. I SAID 'I AM CONFUSED.' I DIDN'T UNDERSTAND WHY WE WERE DSNDING AND THE FO HAD ALL FLAGS WITH HIS RADIO ON THE ILS FREQ. I COULDN'T FIGURE OUT WHICH APCH HE WAS USING, AND I HAD TROUBLE READING HIS CHART FROM ACROSS THE COCKPIT. THEN THE SO MENTIONED THAT WE HAD A 3000 FT MSA. WE WERE AT 2650 FT, AND I TOLD THE FO TO FLY AT 3150 FT WHICH WAS THE ALT FOR THIS POINT ON THE ADF LOCATOR APCH. HE CLBED BACK UP. WE GOT THE 2500 FT LIGHTS ON THE GPWS. I HAD SOME GND CONTACT INTERMITTENTLY, BUT I COULD NOT SEE THE RWY. THEN THE FO SWITCHED HIS RADIO OVER TO THE VOR FREQ 116.5 EZE AND CONTINUED THE 11-1 APCH USING THE 11-2 PAGE. I THINK THE MAJOR PROBS WITH THIS APCH WERE: NO EARLY KNOWLEDGE OF WHICH RWY OR APCH WE WOULD USE. THE APCH WE WERE FINALLY GIVEN, OR FLEW ANYWAY, DID NOT CONFORM TO ANY OF THE PLATES. WE DID NOT MAINTAIN OUR MSA BTWN ARSOT AND 10 DME EZE. WE WERE CONFUSED ABOUT WHAT GND EQUIP WAS AVAILABLE TO US. I ACCEPTED THE CLRNC FOR A STRAIGHT-IN APCH, NOT KNOWING WHICH APCH. THE SOP WAS NOT FOLLOWED IN THAT THE PF (FO) RESET THE ALT WINDOW. I SHOULD HAVE GOTTEN CLARIFICATION OR REFUSED THE APCH UNTIL WE WERE SURE OF WHAT WE WERE DOING, INSTEAD WE FOUND NO ALT SHOWN FOR WHAT WE WERE DOING.

Figure 2. Narrative of ASRS incident report number 310130, one of the 10 narratives rated as most relevant to the Cali accident. The QUORUM model of this narrative is shown in Table 2. A QUORUM model of the commonalities of this narrative and the Cali documents is shown in Table 3. The analysts' ratings of this narrative are shown in Table 4.

Table 2. A QUORUM model of the narrative of incident number 310130 (figure 2). Relations shown in bold italics are the word pairs that are also found in the query model (table 1) that was derived from the Cali documents. The sum of the relational metric values (RMVs) of the bold italicized relations is 1328. The sum of the other relations is 3185. So, the percentage of this model that is also found in the query model is 100(1328/(1328+3185)) = 29.4261%. As shown in Table 3, when the weights of the relations in this incident model are combined with the weights of the relations in the query model, the relation APCH CHART is seen to be the most important Cali-oriented relation in this narrative. The relations APCH NOT and APCH CTLR are the next most important Cali-oriented relations in this narrative. These three relations are underlined below. In general, relations of the form NOT X or X NOT suggest problems involving X. In this case, the relation APCH NOT suggests problems during the approach phase of flight. The relations APCH CHART and APCH CTLR suggest that the problems involved the approach chart and the approach controller. These indications are confirmed by reading the incident narrative in Figure 2. Similar difficulties were encountered just prior to the Cali accident.*

word1	word2	RMV
APCH	STRAIGHT	186
APCH	***NOT***	135
APCH	***ALT***	120
APCH	***RWY***	117
APCH	***CTLR***	105
APCH	***DME***	94
APCH	PAGE	92
APCH	***FO***	88
APCH	***VOR***	73
RWY	ILS	71
APCH	ADF	71
APCH	LOCATOR	70
APCH	***CHART***	67
FO	RADIO	65
RWY	***NOT***	61
FO	ALT	61
RWY	LAND	59
RWY	CIRCLE	59
NOT	STRAIGHT	58
FO	NOT	51
ALT	WINDOW	51
DME	***VOR***	50
APCH	***BUT***	49
LOC	BUT	48
RWY	***VOR***	47
APCH	***USING***	44
APCH	KNOWLEDGE	44
APCH	ILS	44
APCH	EARLY	44
STRAIGHT	DME	43
APCH	***USE***	43
APCH	PF	42
APCH	***ALTS***	42
ALT	PF	42
ALT	DME	42
RWY	STRAIGHT	41
FO	FREQ	41
APCH	CALLED	40
APCH	SETTLED	39
LOCATOR	ADF	38
FO	PF	38
FO	LOC	38
APCH	PROBS	38
RADIO	FREQ	37
FO	SET	37
DME	EZE	37
APCH	APPROPRIATE	37
STRAIGHT	LOCATOR	36
RWY	***DME***	36
RWY	BUT	36
NOT	BUT	36
LAND	CIRCLE	36
CTLR	SAID	36
APCH	MAJOR	36
APCH	KNOWING	36
APCH	LOC	35
APCH	FREQ	35
VOR	EZE	34
NOT	***DME***	34
APCH	WINDOW	34
NOT	SOP	33
NOT	KNOWING	33
FO	***CTLR***	33
APCH	MINIMUM	33
VOR	PAGE	32
VOR	OVER	32
FO	DSNDING	32
APCH	TRYING	32
APCH	THINK	32
APCH	SOP	32
APCH	FINALLY	32
ALT	CTLR	32
WINDOW	PF	31
RWY	APCHS	31
NOT	PLATES	31
NOT	FOLLOWED	31
NOT	CONFORM	31
FO	WINDOW	31
APCH	***RADIO***	31
APCH	MEANWHILE	31
LOC	ANYTHING	30
FO	BUT	30
APCH	SECTOR	30
APCH	***LAND***	30
APCH	GIVEN	30
ALT	DOING	30
STRAIGHT	BUT	29
RADIO	DSNDING	29
NOT	MAINTAIN	29
FO	***RWY***	29
APCH	CIRCLE	29
ALT	ALTS	29
SAID	DSNDING	28
RWY	LOC	28
RADIO	LOC	28
ILS	CIRCLE	28
DSNDING	UNDERSTAND	28
DSNDING	CONFUSED	28
DSNDING	AM	28
CTLR	ALTS	28

Table 3. Derivation of the intersection model and the relevance ranking value (RRV) for the narrative of ASRS incident number 310130 (figure 2). The intersection model represents features of the narrative that are relevant to the Cali accident. The intersection model is based on word pairs that appear in both the Cali query model (Table 1) and the incident model (Table 2). For example, the word pair APCH CHART appears in both the query model and the incident model. Accordingly, the relational metric value (RMV) of APCH CHART in the query model (277, in column 3) is multiplied by the RMV in the incident model (67, in column 4) to produce the RMV of APCH CHART in the intersection model (18559, in column 5). The notes below the table show how the QUORUM relevance ranking value for this narrative is derived from this table, and how the QUORUM relevance rating is derived from the RRV.

probe term	term-in-context	RMV in Cali query	RMV in incident model	product of RMVs
APCH	CHART	277	67	18559
APCH	NOT	33	135	4455
APCH	CTLR	27	105	2835
APCH	DME	21	94	1974
APCH	VOR	22	73	1606
APCH	RWY	13	117	1521
APCH	USE	26	43	1118
APCH	FO	12	88	1056
APCH	USING	22	44	968
RWY	VOR	18	47	846
APCH	RADIO	14	31	434
RWY	DME	12	36	432
FO	CTLR	8	33	264
APCH	ALTS	6	42	252
APCH	LAND	7	30	210
NOT	DME	6	34	204
APCH	BUT	4	49	196
DME	VOR	3	50	150
RWY	NOT	2	61	122
APCH	ALT	1	120	120
FO	RWY	2	29	58

To calculate the RRV:

$$\mathbf{RRV} = S * F * W_i / W_{max} = 37380 * 0.294261 * 555 / 2000 = \mathbf{3052}$$

where

- S = sum of products of RMVs (sum of last column) = 37380
- F = fraction of incident model that is matched by Cali model ; from table 2, F=29.4261%
- W_i = number of words in incident narrative 310130 = 555
- W_{max} = a number larger than the number of words in the longest narrative in the database = 2000

To convert QUORUM's relevance ranking value (RRV) to QUORUM's rating:

rating = truncate(-0.75 + $\log_{10}$(RRV * (10^8 / max_RRV)))
if(rating>7)rating=7
if(rating<1)rating=1

This calculation maps the RRVs into the same seven-level rating scale used by the analysts.
From Appendix 3, Table 1, max_RRV = 31696, so, given RRV of 3052, **rating = 6**

Thus, in Appendix 3, Table1, the QUORUM relevance ranking value (RRV) associated with ASRS incident number 310130 is 3052 and the QUORUM rating is 6.

Table 4. Analysts' ratings of narrative 310130. The narrative is shown in figure 2. The analysts responded to each of the six assertions of relevance by selecting among the seven responses.

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
310130	analyst 1	6	6	7	6	5	6
	analyst 2	6	6	6	7	6	6
	analyst 3	7	7	7	7	7	7

Assertions of relevance

A) In some ways, the context of this incident is similar to the context of the Cali accident.

B) Some of the events of this incident are similar to some of the events of the Cali accident.

C) Some of the problems of this incident are similar to some of the problems of the Cali accident.

D) Some of the human factors of this incident are similar to some of the human factors of the Cali accident.

E) Some of the causes of this incident are similar to some of the causes of the Cali accident.

F) In some ways, this incident is relevant to the Cali accident.

Responses

1: strongly disagree

2: disagree

3: somewhat disagree

4: undecided

5: somewhat agree

6: agree

7: strongly agree

Number of relevant incidents identified by each analyst.

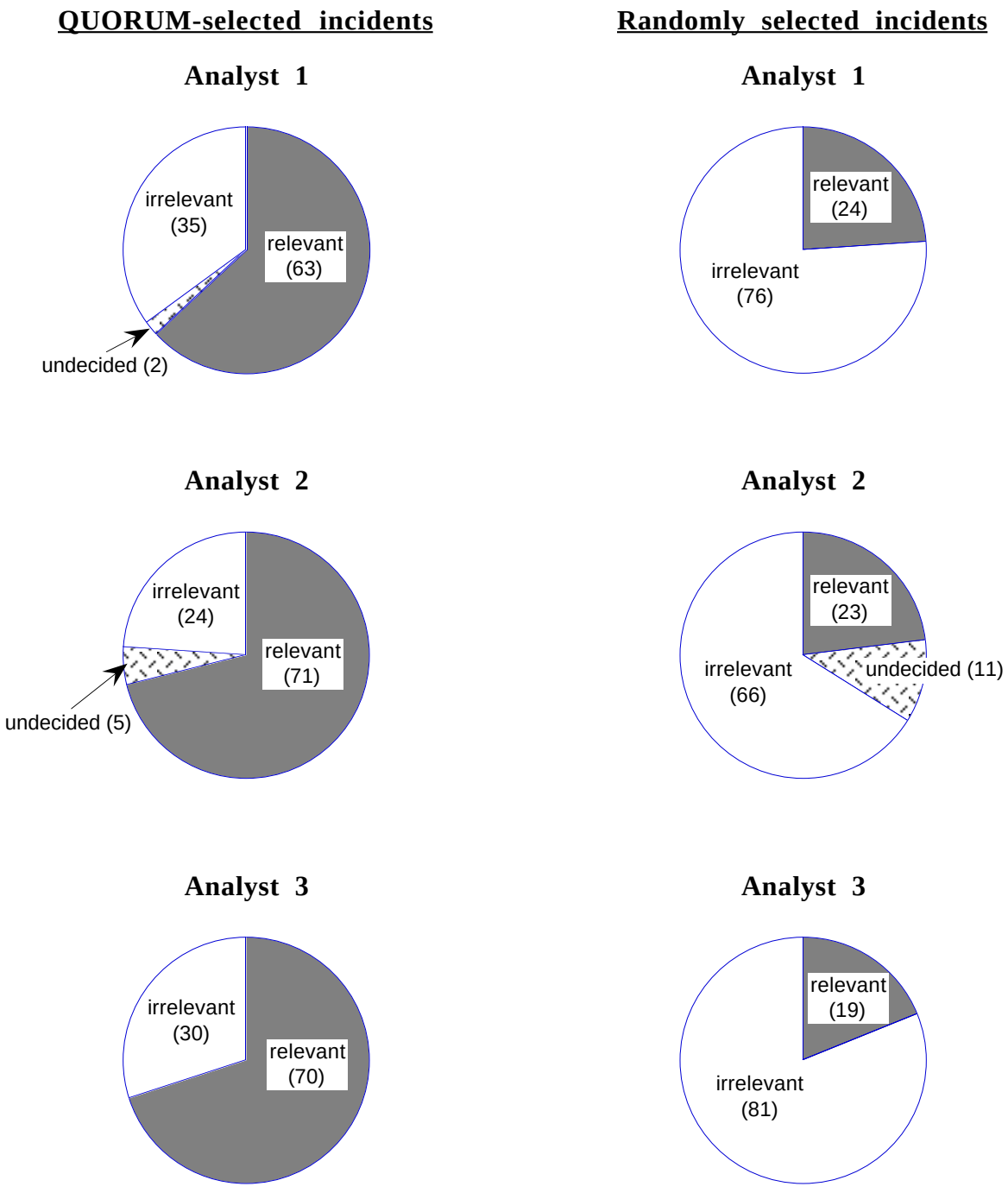

Figure 3. Number of relevant incidents, among 100 QUORUM-selected incidents and 100 randomly selected incidents,identified by each analyst.

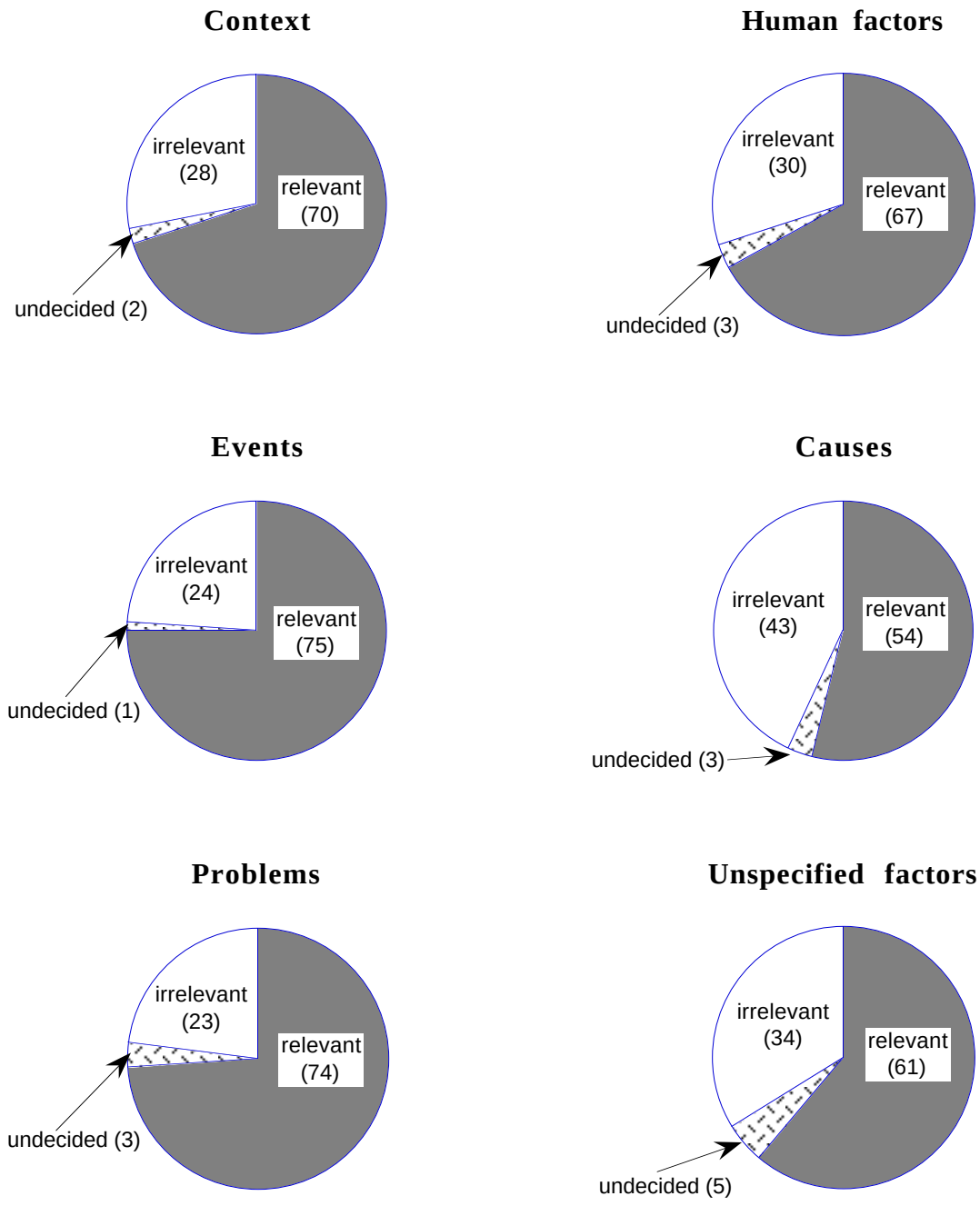

Figure 4. Number of QUORUM-selected incidents that are relevant to the context, events, problems, human factors, causes, or unspecified factors of the Cali accident. In this figure, an incident is counted as relevant if one or more of the analysts rated the incident as relevant.

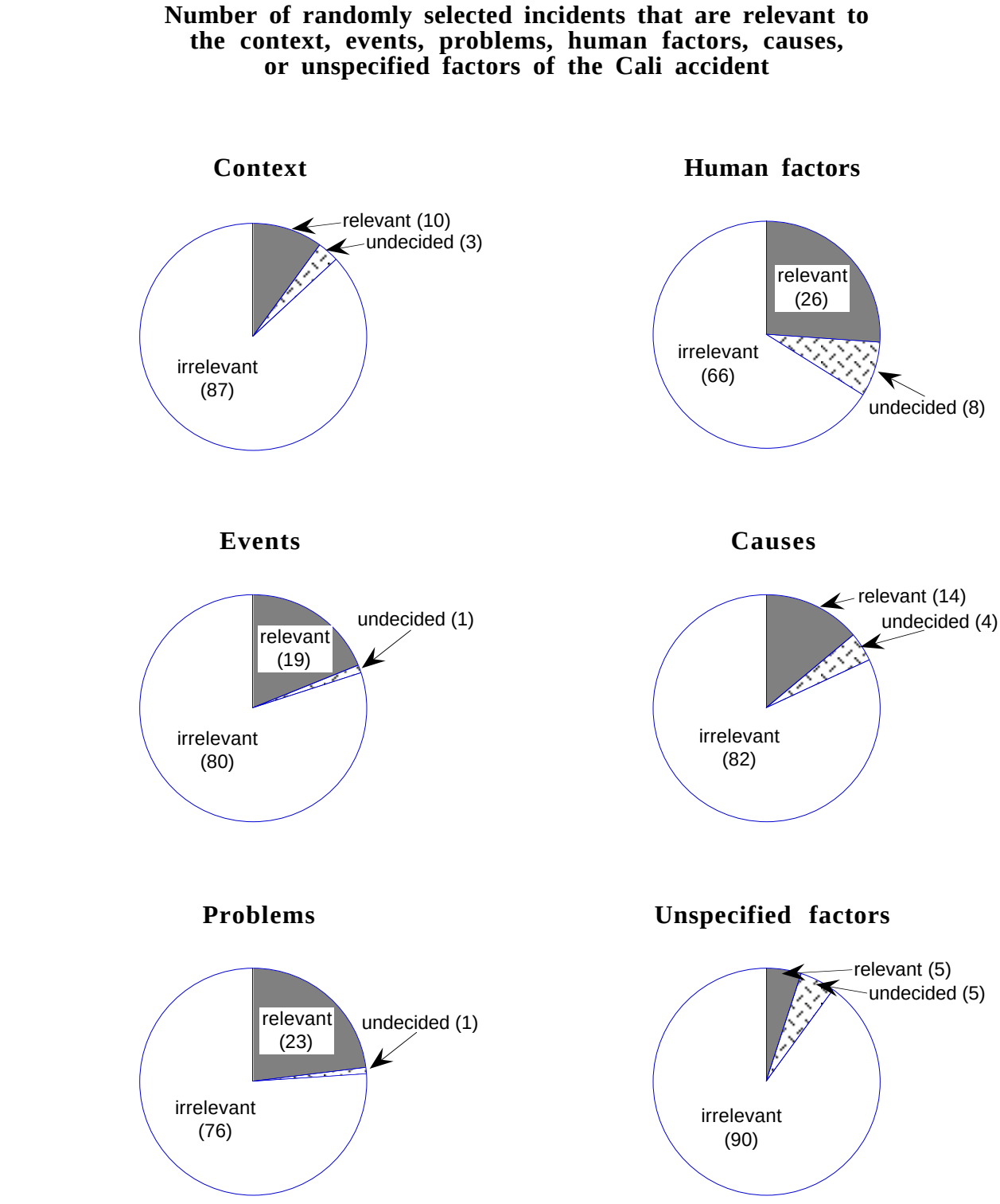

Figure 5. Number of randomly selected incidents that are relevant to the context, events, problems, human factors, causes, or unspecified factors of the Cali accident. In this figure, an incident is counted as relevant if one or more of the analysts rated the incident as relevant.

Consensus among analysts:
Number of incidents rated as relevant to the Cali accident
by N of 3 analysts

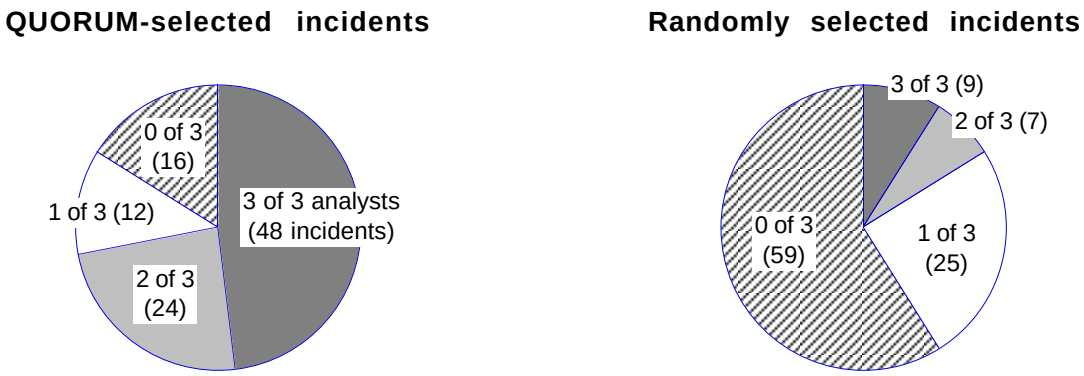

Figure 6. Consensus among analysts regarding the number of incidents relevant to the Cali accident, comparing results for QUORUM-selected incidents and those selected randomly. These pie charts show the number of QUORUM-selected incidents and randomly selected incidents that were rated as relevant by 3 of 3 analysts, 2 of 3 analysts, 1 of 3 analysts, and 0 of 3 analysts. All three analysts rated 48 of 100 QUORUM-selected incidents as relevant, compared with only 9 of the randomly selected incidents. At least two of three analysts rated 72 of 100 QUORUM-selected narratives as relevant, compared with only 16 of 100 randomly selected narratives. Of the 100 QUORUM-selected narratives, 84 were rated as relevant by at least one analyst. Of the 100 randomly selected narratives, 41 were rated as relevant by at least one analyst.

Degree of relevance:
Number of incidents rated as relevant to the Cali accident
in response to N of 6 assertions of relevance

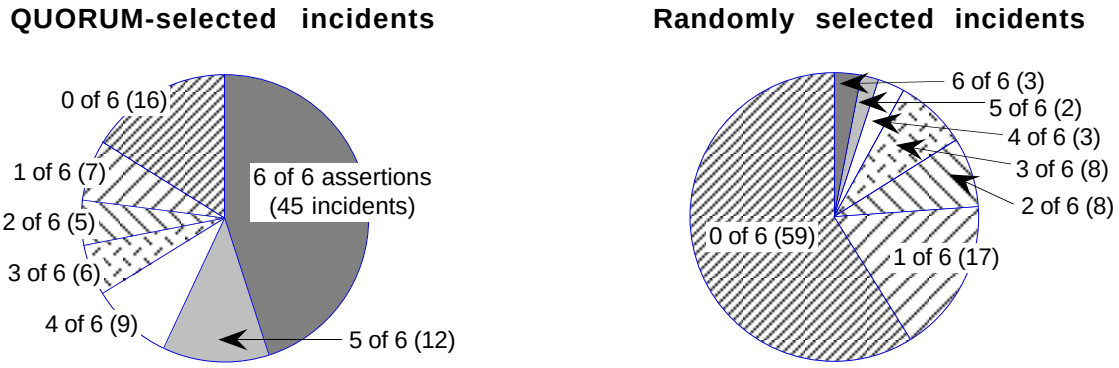

Figure 7. Degree of relevance: Number of incidents rated as relevant to the Cali accident in response to N of 6 assertions of relevance. Agreement with more than one assertion of relevance indicates a greater degree of relevance. These two pie charts show that the analysts found many of the QUORUM-selected incidents to be highly relevant, while few of the randomly selected incidents were highly relevant. For example, in ratings of 45 of the QUORUM-selected incidents, each of the 6 statements of relevance was agreeable to one or more of the analysts, while only 3 of the randomly selected incidents were rated as relevant for all six statements. Eighty-four of the 100 QUORUM-selected incidents were judged to have at least one relevant factor, while only 41 of the randomly selected incidents had at least one relevant factor.

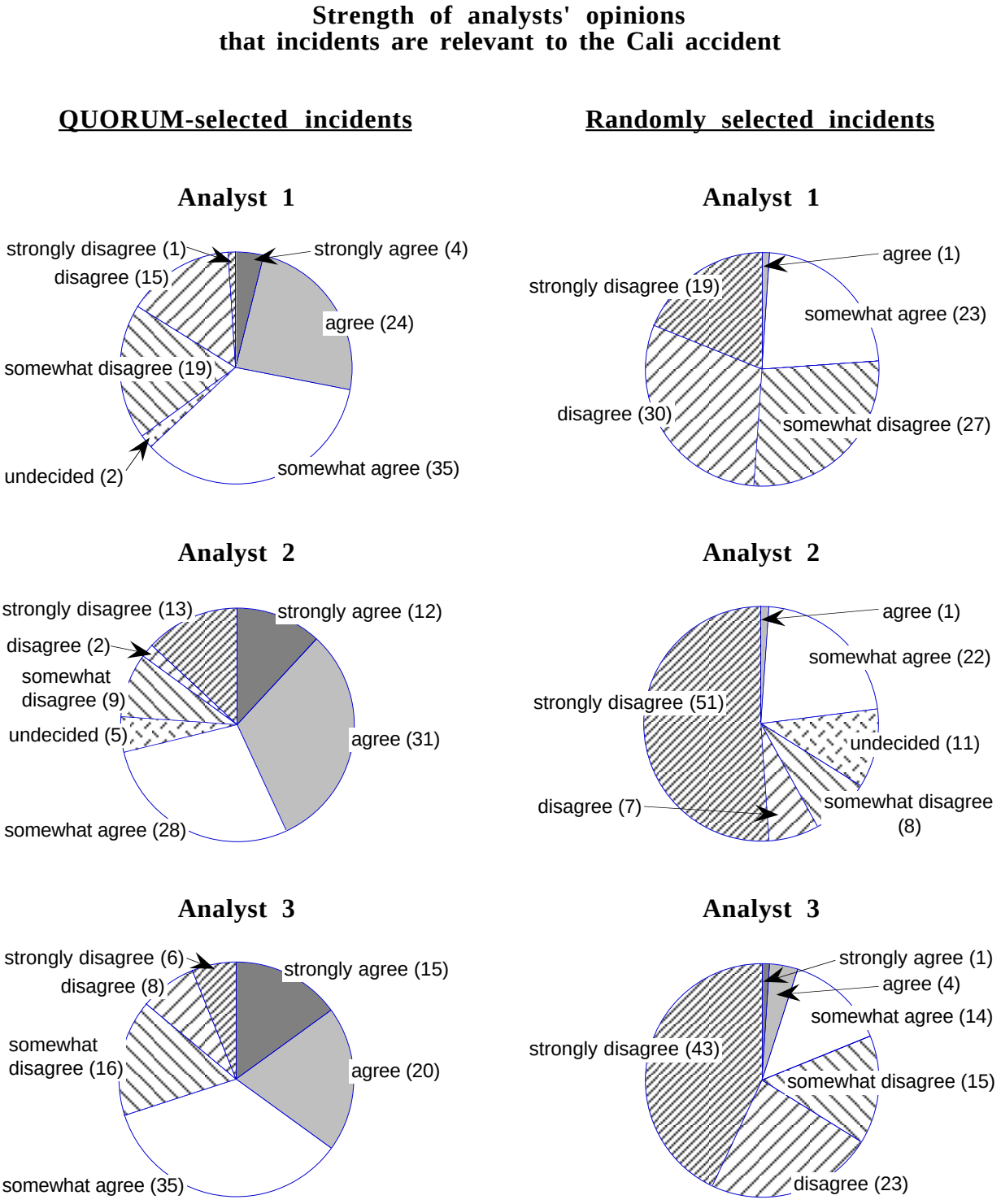

Figure 8. Strength of analysts' opinions that incidents are relevant to the Cali accident, comparing results for QUORUM-selected incidents and randomly selected incidents. Each pie chart shows the number of incidents whose highest rating across assertions of relevance was one of the following: 7: strongly agree, 6: agree, 5: somewhat agree, 4: undecided, 3: somewhat disagree, 2: disagree, or 1: strongly disagree. Overall, the analysts more strongly agreed that the QUORUM-selected incidents, rather than the randomly selected ones, are relevant to the Cali accident. Further, they more strongly disagreed that the randomly selected incidents are relevant.

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Appendix 1.

Methods of modeling and ranking

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Appendix 1. This appendix describes a method of modeling bodies of text (including one or more documents, parts of documents, paragraphs, sentences, or word groups), generating query models, comparing models, and ranking collections of models according to their similarity to a query model, thereby obtaining the similarity-based ranking of documents in a collection. The degree of similarity is interpreted as the degree of relevance to the query. Steps marked with an asterisk (*) were not used in the Cali project.

Generate proximity-weighted co-occurrence model

1. Identify the terms in a body of text. Each term can be one or more marks or characters, such as: a single punctuation mark; a sequence of marks and/or characters; a word; a linked set of marks, characters, or words; a tagged set of marks, characters, or words; or any combination of these. Ignore any terms that are on the stoplist, that is, terms that are not of interest in the analysis. If desired, special sections (e.g., titles, headers, tables, captions, tables of contents, indices, or other sections) may be differentiated from the body of text or incorporated into it.
2. If desired, map specific classes of terms to other terms, as in mapping certain domain terms to non-word place holders. For example, "callback conversation," a phrase sometimes inserted into incident narratives by the ASRS, can be mapped to "nonword nonword."
3. If desired, standardize the vocabulary, such as by converting multiple disparate forms of terms to a single representation, linking terms, tagging terms, changing case, or any combination of these. Once the vocabulary is standardized, return to step 1. Terms especially appropriate for linking are those which should not, do not, or only rarely stand alone as individual terms.
4. Map terms as needed to ease computer-based parsing and use of regular expressions.
5. Generate a list of terms and their frequencies of occurrence in the body of text.
6. Select a number of the most frequently occurring terms to serve as probe terms. If desired, exclude terms on the stoplist.
7. If desired, use only the probe terms having particular tags or other distinguishing characteristics.*
8. If desired, expand the list of probe terms by including synonyms of those already on the list, and scaling their frequencies accordingly.*
9. At each occurrence of each probe term in the body of text, do steps 9.1 through 9.4.

9.1. Identify the terms in proximity to the probe term, to some distance from the probe term, as being among the terms-in-context of the probe term. The terms-in-context are considered to be in the context of each occurrence of the probe term. Instances of the probe term that are in the context of an occurrence of the probe term are considered to be terms-in-context of that occurrence. If desired, ignore terms-in-context that are on the stoplist.

9.2. Consider each unique pair, consisting of a probe term and a term-in-context, as a relation having a value.

9.3. For the current context, assign a value to each relation based on the proximity of each instance of the term-in-context to the probe term. This is a proximity value.

9.4. For each unique relation found in this context, accumulate the sum of the proximity values. Each sum, accumulated across all contexts, is the relational metric value (RMV) of the relation within this particular body of text.

10. List the unique relations, each with its relational metric value.
11. Rank order the relations based on the magnitudes of the relational metric values.
12. If desired, remove relations that are not of interest (e.g., "BUT NOT"). Remove relations containing stoplisted terms, if this was not done in step 9.1.
13. Use all of the remaining relations, or select a number of the relations having the largest relational metric values.
14. Use this list of relations to represent the body of text from which the relations were derived.

15. If desired, such a list of relations can be synthesized from scratch to represent the model of an idealized, hypothesized, or sought-after body of text.*

Generate models of a collection of text

1. Identify a collection of bodies of text as a database of text.
2. Derive a proximity-weighted co-occurrence model, as described in the previous section, of each body of text in the database of text to produce a database of models. Each body of text in the database of text corresponds to one model in the database of models.

Generate query model

1. Select one or more bodies of text from any source, including but not limited to the database of text, to serve as the basis of a query. This is the query text. If desired, special sections (e.g., titles, headers, tables, captions, tables of contents, indices, or other sections) may be differentiated from the body of text or incorporated into it.
2. If desired, map prominent query terms or term groups that are not found among the terms or term groups in the database of models to equivalent terms or term groups that are, in fact, found among the terms or term groups in the database of models. For example, map "first officer" to "FO".
3. If necessary, match usage of uppercase and lowercase characters in the query text and the text to be queried.
4. Derive a proximity-weighted co-occurrence model of the query text as described in the first section of this appendix to produce an initial-query model.
5. For each relation in the initial-query model, find any and all instances of the corresponding relation in the database of models. For a relation A B in the initial-query model, where A is a probe term and B is a term-in-context, the relation A B or the relation B A in a database model constitutes a corresponding relation. Find the sum of the relational metric values of all instances of the corresponding relations in the database of models to derive the database RMV for that relation.
6. Divide the RMV of each initial-query relation by the database RMV of that relation to derive the raw inverse query RMV.
7. The probe term and term-in-context of the initial-query relation whose value is the raw inverse query RMV is a raw inverse query relation.
8. The raw inverse query consists of a collection of raw inverse query relations.
9. Multiply the RMV of each relation in the raw inverse query by the frequency of the relation's probe term in the query text and the frequency of the relation's term-in-context in the query text to produce a scaled RMV.
10. If desired, scale all RMVs to convenient magnitudes.
11. If desired, fine-tune the query model by removing relations that are not of interest.*
12. Sort the query relations on the scaled RMV, and take some number of relations having the largest scaled RMVs to serve as the query model.
13. The relation-by-relation product or sum of multiple query models can be used as a query model.*

Compare query model to database models, and rank database models on similarity

1. Compare the query model to each model in the database of models. For each model in the database of models, do steps 1.1 through 1.3.

1.1. For each query relation, if both terms are found in a database model relation, either as probe term or term-in-context, calculate the product of the RMV of the query relation and the RMV of the database model relation. This product is the intersection RMV, the resulting relation is the intersection relation, and the collection of intersection relations is the intersection model. (Functions might usefully modulate the terms and/or product.*)

1.2. Find the sum of the intersection RMVs to produce the raw similarity value associated with the database model and its corresponding body of text in the database of text.

1.3. If the database model has a non-zero raw similarity value, scale the raw similarity value to produce the similarity ranking value, using the scale factors in 1.3.1 through 1.3.4.

1.3.1. One scale factor is calculated by finding the sum of the database model RMVs of relations that are also found in the query model, and dividing this value by the sum of all RMVs of the database model. This favors database models whose shared features are more central to the emphasis of the body of text from which the database model is derived. This tends to favor smaller bodies of text.

1.3.2. A second scale factor is calculated by counting the number of terms in the database body of text that is represented by the current database model, and dividing this value by a number as large or larger than the number of terms in the largest body of text in the database. This favors larger bodies of text, counterbalancing tendencies of other scale factors to favor smaller bodies of text. (Clamping this factor might be useful.*)

1.3.3. An optional scale factor* is calculated by finding the sum of the query model RMVs of relations that are also found in the database model, and dividing this value by the sum of all RMVs of the query model. This favors database models whose shared features are more central to the emphasis of the text on which the query model is based. This tends to favor smaller bodies of text.

1.3.4. Another optional factor * is the number of relations that are shared by the query and the current database model. This favors bodies of text having a greater number of relations in common with the query text.

2. The bodies of text having the largest similarity ranking values are most likely to be similar to the query text, and are most likely to be perceived as being relevant to the query, so the similarity ranking values may be interpreted as relevance ranking values.

3. Sort identifiers of the bodies of text in the database according to the magnitude of their relevance ranking values, with larger values toward the head of the list.

4. Bodies of text whose identifiers are nearer the head of the sorted list are more relevant to the query text.

5. The most relevant bodies of text, as determined by their relevance ranking values and/or other interpretation method(s), may serve as the basis of subsequent query models and, by comparing one or more of the subsequent query models to the database models and ranking the database models on similarity, even more specifically relevant bodies of text may be obtained.*

6. When bodies of text in the database of text are assigned multiple relevance ranking values (RRVs) with respect to multiple, separate query models, the product of the multiple RRVs can be used to relevance-rank the text on the logical "and" of the multiple queries.*

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Appendix 2.

Rating materials

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INSTRUCTIONS to RATERS

Read each narrative. After reading each narrative, re-read each statement (A-F) below and respond to each statement by selecting one of the possible responses (1-7). On the response form, circle the response number you selected.

Use a pencil with soft lead. Erase thoroughly if any changes must be made.

After you read each narrative, it is very important that you re-read each statement (A-F) just before responding to it. So, after reading a narrative, you should re-read statement A, select one response from among the responses numbered 1-7, and circle that response on your response form. You should then re-read statement B, select among the responses, and circle that response on your response form. And so on. Be sure to respond to all six statements (A-F) for every narrative.

Respond to each statement on its own merits. Ignore relationships among the statements.

You may re-read all or part of a narrative as often as you wish.

Please write your initials at the bottom of every page of the response form.

Statements:

A) In some ways, the context of this incident is similar to the context of the Cali accident.

B) Some of the events of this incident are similar to some of the events of the Cali accident.

C) Some of the problems of this incident are similar to some of the problems of the Cali accident.

D) Some of the human factors of this incident are similar to some of the human factors of the Cali accident.

E) Some of the causes of this incident are similar to some of the causes of the Cali accident.

F) In some ways, this incident is relevant to the Cali accident.

For each narrative, select one of these responses for each statement:

1	2	3	4	5	6	7
strongly disagree	disagree	somewhat disagree	undecided	somewhat agree	agree	strongly agree

Appendix 2. Figure 1. Instructions to raters.

AND HIGH TERRAIN OF EITHER SIDE OF THE STAR ROUTING. WHEN I CHKED THE POINTS ON THE STAR AGAINST OUR CURRENT DIRECT THE VOR RTE OF FLT IT LOOKED LIKE WE WOULD BE VERY CLOSE TO THE STAR ROUTING. WHEN YOU ARE 200 MI OUT, A 15 MI DIFFERENCE IS BARELY NOTICEABLE. FURTHER CHKING OF THE AREA CHART AND OUR DIRECT THE VOR ROUTING SHOWED TERRAIN AT 14000 FT TO 11000 FT DIRECTLY ALONG OUR PATH. A SIMILAR ATC CLRNC HAPPENS VERY OFTEN FLYING INTO LIMA, PERU. MANY, MANY, MANY PLTS ARE NOT AWARE OF JUST HOW CRUCIAL IT IS NOT TO ACCEPT THESE DEADLY CLRNCS. PLEASE GET THE WORD OUT AGAIN.

310989

ACR X ISSUED CLRNC TO 'FLY HDG 230 DEGS, INTERCEPT THE SAN FRANCISCO 095 DEG RADIAL, DSND AND MAINTAIN 11000 FT.' I THEN REQUESTED THE FMS BRIDGE VISUAL RWY 28R. TRACON CLRED US DIRECT ARCHI. ON ABOUT 9 PREVIOUS OCCASIONS, I HAD ARRIVED AT ARCHI WITHOUT ANY ADDITIONAL RTE CLRNC. IT IS NOT CLR THAT THE ORIGINAL CLRNC TO INTERCEPT THE SFO 095 DEG STILL APPLIES AFTER BEING AMENDED TO FLY DIRECT ARCHI. IN FACT, ON AT LEAST SOME OF THE PRIOR OCCASIONS, THE FMS WAS REQUESTED WITH TRACON WITH CHK-IN, AND THEIR ORIGINAL RTE CLRNC WAS SIMPLY TO FLY DIRECT ARCHI, LEAVING US TO ARRIVE OVER ARCHI WITH NO FURTHER RTE OR APCH CLRNC. OUR TURNS ON SOME OF THESE PREVIOUS OCCASIONS TO COURSE 275 WERE MADE ON ASSUMPTION! ON THIS OCCASION, APCHING ARCHI, I QUERIED 134.5 ABOUT OUR CLRNC AFTER ARCHI. BAY APCH RESPONDED, 'INTERCEPT THE FINAL APCH COURSE.' THIS WAS THE FIRST TIME I HAD HEARD THE TERM 'FINAL APCH COURSE' REFERRING TO THE SFO 095 DEG RADIAL. I INQUIRED AGAIN FOR CLARIFICATION, 'THAT IS NOT CLR TO ME, SHOULD WE INTERCEPT THE SAN FRANCISCO 095 DEG RADIAL?' THE CTLR INSISTED ON USING ONLY THE TERMINOLOGY 'FINAL APCH COURSE' AND WOULD NOT RESPOND OTHERWISE TO MY REPEATED ATTEMPTS TO RECONCILE MY UNCERTAINTY ABOUT INTERCEPTING THE SFO 095 DEG OR INTERCEPTING, JUST BEYOND ARCHI, THE RWY 28R LOC OR CTRLINE. AT ARCHI, WE TURNED TO A COURSE OF 275 ON THE ASSUMPTION THAT IT WAS OUR 'FINAL APCH COURSE.' THIS AMBIGUITY WAS PROMPTLY RESOLVED ON THE SUBSEQUENT BAY APCH FREQ 135.65. THIS TERMINOLOGY DOESN'T MEET THE LOGICAL DEFINITION OF A 'FINAL' APCH COURSE. THE FMS BRIDGE VISUAL RWY 28R APCH CHANGES COURSE 2 MORE TIMES BEFORE ARRIVING AT THE RWY. NOR DOES IT APPEAR TO MEET THE AIM DEFINITION OF 'FINAL APCH COURSE' AS PUBLISHED IN FLT OPS MANUAL. NOR DOES IT SERVE THE PURPOSE OF CLRLY DISTINGUISHING A CLRNC TO INTERCEPT THE VOR RADIAL OR THE RWY LOC AND CTRLINE. I SUGGEST 1) BAY APCH PROC BE CHANGED SO THAT A RTE CLRNC OR EXPECT FURTHER RTE CLRNC IS ISSUED WITH THE CLRNC TO FLY DIRECT ARCHI, AND 2)

Appendix 2. Figure 2. Example page from the bound collection of 200 narrratives that were read by the analysts.

198046
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

198841
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

274027
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

315261
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

280233
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

209811
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

370656
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

280530
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

197507
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

217430
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

116871
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

301538
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

310143
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

310989
A: 1 2 3 4 5 6 7
B: 1 2 3 4 5 6 7
C: 1 2 3 4 5 6 7
D: 1 2 3 4 5 6 7
E: 1 2 3 4 5 6 7
F: 1 2 3 4 5 6 7

Appendix 2. Figure 3. Example page from booklet of response forms.

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Appendix 3.

Ratings of the 200 incident narratives read by the analysts,
showing the QUORUM-calculated relevance ranking values (RRVs),
QUORUM's ratings derived from the RRVs,
and ratings by each of the analysts

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Appendix 3. Table 1. Ratings of the 100 QUORUM-selected incident narratives. The incidents are sorted in order of the analysts' relevance ratings. The more highly rated incidents appear nearer the head of this list. The ASRS accession numbers of each incident are shown in column 1 (accnum). The relevance ranking values (RRVs) in column 2 were computed by QUORUM, based on the intersection (see example in table 3) between the query model (table 1) and each narrative model (see example in table 2). The QUORUM ratings in column 3 (labeled Q) are computed from the RRVs, as described in table 3. Ratings shown for each of the three analysts (A1, A2, A3) are their maximum ratings across the six assertions of relevance. This indicates whether the analyst saw any relevance in the narrative. For example, a rating of 7 indicates that the analyst "strongly agreed" with at least one of the six assertions of relevance. The last 16 incidents on this list, shown in italics, were rated by the analysts no higher than 4 ("undecided"), indicating that they found no relevance in these incidents. More detail is available elsewhere in this report about the top 11 incidents. The narrative of incident 310130 is shown in Fig. 2, and all of the analysts' ratings for that incident are shown in Table 4. The narratives and all of the analysts' ratings for the next 10 incidents, 368360-223467, are shown in Appendix 4, Figures 1-10.

accnum	RRV	Q	A1	A2	A3
310130	3052	6	7	7	7
368360	11483	6	7	7	7
272508	6158	6	7	6	7
280233	7214	6	6	7	7
315261	4012	6	6	7	7
347848	9726	6	7	6	7
349669	2869	6	6	7	7
363536	10542	6	6	7	7
310143	24955	7	5	7	7
310228	4735	6	3	7	7
223467	3974	6	6	6	7
334866	4001	6	6	6	7
351150	8316	6	6	7	6
184380	6426	6	5	7	6
212324	6327	6	6	5	7
274820	3713	6	5	6	7
306151	2633	6	5	6	7
335098	2661	6	5	7	6
226114	4086	6	3	7	5
142553	5395	6	6	6	6
146645	7106	6	6	6	6
224363	2574	6	6	6	6
310373	17066	6	6	6	6
334006	4234	6	6	6	6
352618	4305	6	6	6	6
116871	7215	6	6	6	5
117306	6867	6	6	6	5
244767	2684	6	5	6	6
296506	2735	6	6	6	5
301760	8371	6	6	6	5
321136	3124	6	6	5	6
341815	4676	6	6	6	5
353338	7910	6	2	6	6
140711	3067	6	6	1	6
160843	31696	7	5	6	5
217430	4898	6	5	6	5
219222	3034	6	5	6	5
279030	2843	6	5	5	6
297695	5095	6	5	5	6
302770	4675	6	5	6	5
305840	4253	6	6	5	5
359641	9430	6	6	5	5
82787	2999	6	5	6	5
363380	3641	6	5	4	6
153355	2406	6	6	5	3
174048	4631	6	3	6	5
201005	2465	6	3	5	6
238398	3179	6	3	6	5
251901	2557	6	3	5	6
307543	7958	6	3	6	5
317197	3505	6	5	6	3
330250	2612	6	3	6	5
325026	7878	6	5	6	2
362229	2983	6	2	6	5
156284	4664	6	2	4	6
310989	14024	6	4	2	6
156414	4762	6	5	5	5
184446	7494	6	5	5	5
198046	3758	6	5	5	5
242545	2982	6	5	5	5
275413	4687	6	5	5	5
335430	5837	6	5	5	5
346137	5557	6	5	5	5
361956	5096	6	5	5	5
365456	3330	6	5	5	5
335282	9002	6	5	4	5
300252	7941	6	3	5	5
329185	3011	6	3	5	5
342838	4584	6	5	5	3
358123	6317	6	3	5	5
84811	5349	6	5	5	3
115883	2736	6	5	5	2
354277	6222	6	2	5	5
307161	10147	6	5	5	1
303310	2323	6	5	4	3
264952	6695	6	5	3	3
279493	6803	6	5	3	3
350190	3118	6	5	3	3
355364	2948	6	3	5	3
242560	2612	6	2	5	3
249654	4542	6	2	3	5
309352	3498	6	2	3	5
282707	3565	6	5	1	3
99108	3018	6	3	1	5
260432	*9963*	*6*	*4*	*3*	*1*
280922	*9001*	*6*	*2*	*4*	*2*
325365	*4521*	*6*	*3*	*3*	*3*
308422	*4712*	*6*	*2*	*3*	*3*
228422	*3901*	*6*	*3*	*1*	*3*
355188	*2659*	*6*	*3*	*1*	*3*
313511	*5440*	*6*	*2*	*2*	*3*
112422	*2386*	*6*	*1*	*3*	*2*
281636	*3187*	*6*	*3*	*1*	*2*
370656	*6793*	*6*	*3*	*1*	*2*
332870	*2503*	*6*	*3*	*1*	*1*
148439	*2708*	*6*	*2*	*1*	*2*
342160	*3508*	*6*	*2*	*1*	*2*
325432	*10172*	*6*	*2*	*1*	*1*
340978	*2313*	*6*	*2*	*1*	*1*
360500	*3416*	*6*	*2*	*1*	*1*

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 3. Table 2. Ratings of the 100 randomly selected incident narratives. The incidents are sorted in order of the analysts' relevance ratings. The more highly rated incidents appear nearer the head of this list. The ASRS accession numbers of each incident are shown in column 1 (accnum). The relevance ranking values (RRVs) in column 2 were computed by QUORUM, based on the intersection (see example in table 3) between the query model (table 1) and each narrative model (see example in table 2). The QUORUM ratings in column 3 (labeled Q) are computed from the RRVs, as described in table 3. Ratings shown for each of the three analysts (A1, A2, A3) are their maximum ratings across the six assertions of relevance. This indicates whether the analyst saw any relevance in the narrative. For example, a rating of 7 indicates that the analyst "strongly agreed" with at least one of the six assertions of relevance.

accnum	RRV	Q	A1	A2	A3												
137942	102	4	5	5	7	329210	0	1	1	5	2	280530	0	1	3	1	1
168420	612	5	6	5	5	352880	0	1	1	5	2	288665	0	1	1	1	3
184917	0	1	5	5	6	374411	0	1	5	1	2	299682	0	1	3	1	1
232995	0	1	5	6	2	98676	0	1	5	1	2	339510	0	1	3	1	1
276144	0	1	2	5	6	217405	19	4	1	1	5	349077	7	3	3	1	1
185995	4	3	2	1	6	289604	0	1	5	1	1	231377	0	1	1	2	2
369400	0	1	1	1	6	326579	14	3	1	5	1	273126	0	1	2	2	1
121942	0	1	5	5	5	334370	1	2	3	4	3	311780	0	1	2	1	2
123523	6	3	5	5	5	269069	0	1	2	4	3	336170	0	1	2	1	2
133697	0	1	5	5	5	224527	0	1	2	4	2	363445	0	1	2	1	2
137377	2	3	5	5	5	135427	0	1	1	4	1	197399	0	1	1	1	2
299590	32	4	5	5	5	167263	0	1	2	3	3	199234	0	1	2	1	1
317302	2	3	5	5	5	205316	11	3	3	3	2	221398	20	4	2	1	1
120627	6	3	3	5	5	348150	0	1	3	2	3	227582	0	1	2	1	1
124286	0	1	5	5	3	164488	0	1	3	1	3	233097	0	1	2	1	1
294893	0	1	5	5	2	221067	57	4	3	3	1	236441	0	1	2	1	1
301538	0	1	5	2	5	236993	1	2	3	1	3	243432	7	3	2	1	1
80231	0	1	5	5	2	119934	0	1	2	3	2	250185	0	1	2	1	1
163375	0	1	3	4	5	88123	10	3	3	2	2	266321	0	1	2	1	1
226033	0	1	3	4	5	129682	0	1	2	1	3	285669	0	1	2	1	1
92389	0	1	5	4	3	145934	0	1	2	3	1	301427	0	1	2	1	1
197507	48	4	5	4	2	164303	0	1	2	1	3	310662	0	1	2	1	1
296006	0	1	5	4	2	176239	0	1	3	1	2	319332	3	3	2	1	1
93994	0	1	5	4	2	305310	0	1	1	3	2	345249	0	1	2	1	1
294068	0	1	1	4	5	307714	0	1	2	1	3	358446	0	1	2	1	1
125733	0	1	3	2	5	107473	0	1	3	1	1	363100	16	3	2	1	1
184142	0	1	5	3	2	137871	2	3	1	1	3	150685	0	1	1	1	1
357280	60	4	2	5	3	154070	0	1	3	1	1	159808	0	1	1	1	1
119343	76	4	1	5	3	181017	0	1	3	1	1	173602	0	1	1	1	1
236719	0	1	3	5	1	196326	0	1	3	1	1	245613	0	1	1	1	1
274027	58	4	5	3	1	198841	0	1	3	1	1	272741	0	1	1	1	1
297200	12	3	3	5	1	209811	0	1	3	1	1	282765	0	1	1	1	1
324025	0	1	3	5	1	211265	0	1	3	1	1						
114244	1	2	5	2	2	249845	0	1	3	1	1						

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4.

Ten of the incidents rated as
highly relevant to the Cali accident

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368360
AFTER DEPARTING FRG ARPT, ENRTE TO OUR FIRST DEP FIX, WE WERE INSTRUCTED BY ATC TO FLY A HDG OF 360 DEGS BECAUSE OF A LINE OF TSTMS JUST W OF OUR DEP FIX. THE CTLR TOLD US TO MAINTAIN FL280 AND CONTACT ZNY FOR A RERTE. WE CONTACTED ZNY, WHO ISSUED A NEW ROUTING TO US. AS I WAS ENTERING THE DATA IN THE FMS IT BECAME CLR TO ME THAT THIS ROUTING TO PWK (OUR DEST) WAS INVALID, AS THE FMS WAS NOT TAKING THE INFO. I ASKED MY FO TO CLARIFY THE ROUTING WITH ATC. HE ATTEMPTED TO DO SO BUT WE WERE GIVEN A FREQ CHANGE AT THIS TIME TO ZBW. ON OUR INITIAL CALL TO ZBW, HE TOLD US TO FLY DIRECT TO ALB VOR, CLB TO FL310 AND WHEN ABLE PROCEED DIRECT SYR VOR. AT THIS TIME I AGAIN ASKED MY FO TO CLARIFY THE ROUTING AFTER SYR. WE WERE AGAIN GIVEN INVALID ROUTING (RTE BREAK ON FMS). AT THIS POINT MY FO BECAME ENGROSSED IN LOOKING ON OUR HIGH AND LOW ALT ENRTE CHARTS TO FIND WHERE THE PROB WAS. I TRIED AGAIN TO ENTER ROUTING ON THE FMS (THIS TOOK APPROX 2 MINS). I LOOKED UP TO SEE MY FLT INSTS AND AT THIS TIME NOTED THE ALTIMETER READING FL312 AND CLBING. I IMMEDIATELY DISCONNECTED THE AUTOPLT AND ATTEMPTED TO DSND TO FL310, BUT OUR 1000 FPM RATE OF CLB CARRIED US TO FL313 BEFORE CORRECTIVE ACTION WAS INITIATED. APPROX 5 SECONDS LATER ZBW TOLD US TO MAINTAIN FL310. I LOOKED AT MY TCASII DISPLAY WHICH WAS IN THE 'LOOP UP' MODE BUT SAW NO CONFLICTING TFC WITHIN A 40 MI RADIUS. ATC FINALLY GAVE US A RTE THAT WAS VALID AND WE CONTINUED ON TO PWK WITHOUT FURTHER INCIDENT. I BELIEVE THAT THE COMPLEXITY OF FMS PROGRAMMING IS NOT ADDRESSED IN INITIAL TRAINING AT SCHOOL BECAUSE EACH ACFT HAS DIFFERENT EQUIP. HOWEVER, THIS LEAVES THE FLC TO 'LEARN AS THEY FLY.' THIS EFFECTIVELY TOOK MY FO OUT OF THE LOOP IN THAT IF HE WAS PROGRAMMING THE FMS, I COULD HAVE CONCENTRATED MORE ON MONITORING THE ACFT. I SHOULD HAVE LET THE FO FLY THE ACFT WITH THE AUTOPLT RATHER THAN ME DO ALL THE TASKS. THE ENTIRE CREW WAS DISTR, AND WE BOTH FAILED TO MONITOR THE PERFORMANCE OF THE ACFT. I SHOULD HAVE JUST PUT MY HSI IN THE VOR MODE RATHER THAN DISPLAY FMS COURSE INFO. THIS WOULD HAVE ALLOWED US TO FOCUS MORE ON THE ACFT. I BELIEVE, HOWEVER, THAT ALL GA PLTS WITH FMS'S ON BOARD ATTEND FMS SPECIFIC SIMULATOR TRAINING ON THEIR UNITS BEFORE OPERATING AN ACFT WITH THE UNIT INSTALLED. THERE IS NO REG THAT GOVERNS THIS OTHER THAN FAR PART 91 WHICH STATES I MUST BE FAMILIAR WITH THE OP OF ALL EQUIP. SO I AM LEFT TO READ A BOOK ON THE FMS AND THEN GO FLY IT IN REAL LIFE. THIS IS UNACCEPTABLE.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
368360	analyst 1	7	6	6	6	6	6
	analyst 2	2	5	7	6	6	5
	analyst 3	6	6	7	6	6	5

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 1. Narrative of ASRS incident report number 368360, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

272508
I MISSED THE XING RESTRICTION OF 10000 FT AT 'BUMBY' ON THE BATSN.BATSN3 ARR TO HOU. WE HAD BEEN MANEUVERING AROUND TSTMS AND HAD RECEIVED A FEW ROUTING CHANGES, THE LATEST OF WHICH WAS 'DIRECT TO DAS THEN TO THE ARPT.' AS WE APCHED HOU, WE WERE CLRED DIRECT TO BUMBY AND THE REMAINDER OF THE ARR. I STARTED THE AIRPLANE DIRECT TO BUMBY WITH THE FMS AND THEN INSERTED THE XING RESTRICTION OF 10000 FT ON THE LEGS PAGE. I THEN SELECTED THE BATSN-3 ARR FOR USE BY THE FMS. WHAT I FAILED TO NOTICE WAS THAT BY INSERTING THE ARR IN THE FMS, THE COMPUTER DUMPED THE XING RESTRICTION I HAD INSERTED JUST A FEW MOMENTS EARLIER. AT THIS POINT, I FELT COMFORTABLE WITH THE POS OF 'TOP OF DSCNT' POINT AND PROCEEDED TO LOAD IN THE APCH TO RWY 4 (ILS), WHICH HAD CHANGED FROM RWY 12R WITH A NEW ATIS MESSAGE. AT 15 MI PRIOR TO THE DSCNT POINT, I STARTED DOWN AND INTERCEPTED THE DSCNT PROFILE WELL AHEAD OF SCHEDULE. DURING THE DSCNT I BRIEFED THE APCH AND SET UP THE NAV FOR THE ILS. THROUGH ABOUT 17500 FT, APCH CTL ASKED IF WE WOULD MAKE THE BUMBY RESTRICTION (10000 FT) AND IT WAS IMMEDIATELY OBVIOUS THAT WE WOULD NOT AS THE DSCNT LINE WE WERE ON NO LONG WAS USING THE BUMBY RESTRICTION FOR COMPUTATION. THE CTLR STATED THAT IT WAS NOT A PROB AND THAT WE SHOULD JUST KEEP OUR SPD UP AND PROCEED ON THE ARR. THE LNDG WAS COMPLETED WITHOUT FURTHER INCIDENT OR DIFFICULTY. THE CAUSE, I BELIEVE, WAS A COMBINATION OF COCKPIT MGMNT OVERLOAD DURING THE APCH PHASE COUPLED WITH AN OVERCONFIDENCE IN THE FMS TO PRESENT VALID DSCNT PROFILE INFO. I ALLOWED MYSELF TO GET TOO BUSY DURING THE DSCNT TO MAKE ESSENTIAL XCHKS TO CONFIRM THE FMS WAS WORKING AS ADVERTISED. THE CORRECTION: ALWAYS DOUBLE CHK THE FMS DATA AGAINST OTHER AVAILAABLE NAV DATA TO INSURE THAT YOUR PROGRAMMING IS CORRECT AND THAT THE ACFT IS FOLLOWING ACCURATE FMS GUIDANCE. OVERCONFIDENCE IN THE FMS AND INCREASED WORKLOAD IN THE COCKPIT DURING BAD WX AND APCH PREPARATION IS NO EXCUSE FOR SOUND PILOTAGE AND THE MAINT OF SITUATIONAL AWARENESS.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
272508	analyst 1	7	7	7	5	6	6
	analyst 2	5	6	5	6	5	5
	analyst 3	7	7	6	7	6	7

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

*Appendix 4. Figure 2. Narrative of ASRS incident report number 272508, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratin*gs of *the six assertions of relevance, as they apply to this narrative.*

280233
APCH CTL CLRED US TO 7200 FT INITIAL APCH ALT FOR RWY 16R AT RNO. BECAUSE OUR PRESENT ALT WAS HIGHER THAN NORMAL, I CALLED FOR 'GEAR-DOWN' AND EXTENDED SPD BRAKES TO AID DSCNT. I INTERCEPTED RWY 16R LOC AND TRACKED INBOUND WHILE STILL DSNDING. SINK RATE ABOUT 3000 FPM. AT 8200 FT THE ALT ALERT SIGNALED AND THE COPLT AND I EXCHANGED ACKNOWLEDGEMENTS. I RAISED THE NOSE TO ARREST SINK RATE AND DECELERATE AT 7200 FT. APCHING ZERO-FLAP VMA. I APPLIED THRUST AND NOTICED I WAS USING CONSIDERABLY MORE THAN NORMAL TO MAINTAIN LEVEL FLT. AIRSPD WAS 210 KT AND DECAYING. LNDG WT WAS APPROX 120000 LBS AND VMA ABOUT 180 KTS. AT APPROX 200 KTS, I GOT THE STALL SHAKER WITHOUT ANY UNUSUALLY HIGH NOSE ATTITUDE. I INSTINCTIVELY LOWERED THE NOSE AND ADDED THRUST. WE WERE NOW DSNDING BELOW 7200 FT AND BELOW GS PRIOR TO THE OM. AT 6500 FT THE GPWS ISSUED A 'TERRAIN' WARNING. THE FE THEN ALARMED ME THE SPD BRAKES WERE STILL EXTENDED. I IMMEDIATELY RETRACTED THEM, CALLED FOR 'FLAPS-2 DEGS' AND CALLED THE ARPT 'IN-SIGHT.' WE WERE THEN CLRED FOR A VISUAL TO RWY 16L AND MADE A NORMAL APCH AND LNDG. ANALYZING THESE EVENTS, I HAD FORGOTTEN THE SPD BRAKES WERE DEPLOYED. THE LNDG GEAR WAS DOWN TO AID DSCNT BUT WAS NOW A LARGE DRAG DEVICE IN LEVEL FLT. ADDITIONALLY, I WAS IN A NON-STANDARD APCH PROFILE. GETTING THE STALL SHAKER AT 200 KTS CONFUSED ME AND MY INSTINCT TO LOWER THE NOSE AND ADD THRUST WAS TRIGGERED ALTHOUGH I WAS STILL LOSING ALT OVER MOUNTAINOUS TERRAIN. THESE ACTIONS PREVENTED A STALL BUT ACCELERATED ALT LOSS. THE RNO AREA IS MOUNTAINOUS AND WE GOT WITHIN GPWS TERRAIN WARNING RANGE AT 6500 FT. FORTUNATELY, MY FE CALLED MY ATTN TO THE SPD BRAKES. I HAVE BEEN THOROUGHLY TRAINED IN TERRAIN AVOIDANCE MANEUVERS BUT DID NOT EXECUTE THEM SINCE I WAS FOCUSED ON AIRSPD AND ALT CTL. OUR SCHEDULE WAS MSP TO DFW, DFW TO OAK, OAK TO RNO. WE ALL RECEIVED 15 HRS REST PRIOR TO THESE TRIPS YET ALL OF US FELT EXTREMELY LETHARGIC AND FATIGUED UPON ARR AT OAK. WORKING 11:28 HRS OF SCHEDULED DUTY AT THIS TIME OF DAY, I BELIEVE, IS THE MAJOR CAUSE OF THIS FATIGUE FEELING, RESULTING IN A GROSS IMPAIRMENT OF OUR JUDGEMENT. ADEQUATE CREW REST PRIOR TO THIS TRIP PAIRING IS NOT AN ANSWER. A SHORTER DUTY PERIOD IS REQUIRED.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
280233	analyst 1	6	6	5	5	4	5
	analyst 2	7	6	7	7	6	7
	analyst 3	5	6	6	6	7	7

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 3. Narrative of ASRS incident report number 280233, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

315261
DURING OUR INITIAL APCH INTO ONT WE RECEIVED THE FOLLOWING CLRNC, PROCEED DIRECT TO THE PETIS NDB, MAINTAIN 4200 FT TO PETIS, CLRED ILS RWY 26L APCH. WHILE MY FO WAS READING BACK THE CLRNC I ENTERED DIRECT 'FF26L' INTO THE FMC AND PROCEEDED TO FLY INBOUND. A FEW MINS LATER APCH CTL CALLED AND SAID WE WERE 4 NM L OF PETIS AND TO TURN R TO A 320 DEG HDG, MAINTAIN 4200 FT. AT THIS POINT I REALIZED THAT I HAD BEEN FLYING DIRECT TO THE OM (FONTA) INSTEAD OF PETIS NDB. WE THEN RECEIVED ANOTHER APCH CLRNC AND CONTINUED UNEVENTFULLY TO THE ARPT. WE WERE IN VFR CONDITIONS THE ENTIRE TIME AND NEVER HAD ANY TFC OR TERRAIN CONFLICTS. THE FMS NAV DATA BASE LISTS THE OM (FONTA) AS FF26L INSTEAD OF JUST FONTA. MOST NDB'S ARE COLLOCATED WITH THE OM, REFERRED TO AS LOM'S. HUMAN FACTORS BEING WHAT THEY ARE, I SAW FF26L AND USED THAT WAYPOINT THINKING AT THAT MOMENT THEY WERE COLLOCATED AND I WAS FLYING TO PETIS. ACTUALLY THEY ARE ABOUT 5 NM APART. IF THE FMS HAD SHOWN FONTA AS THE OM WAYPOINT INSTEAD OF FF26L I THINK IT WOULD HAVE BEEN CLR THAT THEY ARE IN FACT 2 DIFFERENT POINTS. THERE DOESN'T SEEM TO BE ANY CONSISTENCY WITH THE FMS APCH DATA BASE. SOME APCHS SHOW THE OM NAME AND OTHERS USE THE FF (FINAL FIX) FORMAT. THEY SHOULD ALL USE THE CORRECT FIX NAMES. ADDING TO THE CONFUSION THE APCH DATABASE SHOWS PETIS AS SBNB. OUR SOP DICTATES THE PNF MAKE ALL EXECUTABLE ENTRIES TO THE FMS. THIS KEEPS BOTH PLTS 'IN THE LOOP.' I WAS HAND FLYING AND SINCE WE WERE VERY BUSY AT THE TIME, I MADE THE ENTRY TO SAVE TIME. FOLLOWING SOP MAY HAVE PREVENTED THE MIX-UP. FOLLOW SOP AND STAY ALERT, AND PLEASE MAKE THE DATA BASES MORE USER FRIENDLY!

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
315261	analyst 1	6	6	6	5	5	6
	analyst 2	6	6	7	6	6	6
	analyst 3	6	5	6	6	7	6

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 4. Narrative of ASRS incident report number 315261, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

347848

3 MINS PRIOR TO TOP OF DSCNT, CAPT HAD TO LEAVE FLT DECK TO ATTEND TO PHYSIOLOGIC NEEDS. FO WAS PF FOR LEG AND HAD CIVET ARR PROGRAMMED IN FMS PRIOR TO CAPT LEAVING. HE HAD NOT SELECTED THE RWY AT THAT TIME. WHEN CAPT RETURNED, ACFT WAS PASSING FL280 TO MAKE 140A180B AT CIVET, LNAV/VNAV WAS IN USE. WE WERE CTRED ON LOC COURSE ON 109.9, BUT FO HAD NOT SELECTED EITHER HSI TO 'ILS' MODE SO AS TO RECEIVE DME AND NEITHER VOR WAS IN MANUAL -- TOTAL RELIANCE ON THE 'MAGIC.' CAPT BRIEFLY SELECTED ILS AND VERIFIED DME/LOC CTRED AND WAS OCCUPIED IN COMPLETING APCH SETUP IN FMS, GETTING ATIS, PLANNING DSCNT CHK AND BRIEFING THE APCH FOR FO. FO WAS BEHIND AND NOT CATCHING UP. SEQUENCE IN FMS PROGRAMMING WAS SELECTING RWY 25L, LNAV DIRECT DOWNE, THEN BACK TO DEP/ARR PAGE TO RESELECT RWY 25L, CIVET, ARNES TRANSITION. THIS DROPPED DOWNE AS ACTIVE WAYPOINT, AND STARTED JET IN TURN BACK TO ARNES. FO DID NOT HAVE LOC SELECTED!? LAX APCH GAVE A TURN TO 220 DEG TO REJOIN RWY 25L LOC. THAT'S WHEN CAPT NOTED FO'S STATE OF 'BEHINDNESS,' AND TALKED HIM THROUGH THE STEPS NECESSARY TO COMPLETE APCH 'RAW DATA.' AFTER THAT, THERE WAS BARELY ENOUGH TIME TO COMPLETE THE CHKLISTS, BRIEF THE APCH, AND GET THE JET ON THE GND. FO HAS ERRONEOUSLY SELECTED APCH PRIOR TO 10 DME, PER NOTAMS WHEN INSTRUCTION HAD BEEN SELECT LOC AND GOT LOW (AS A CONSEQUENCE OF THAT) BY 200 FT AT HUNDA (1 DOT LOW). CAPT WAS TASK SATURATED AS WELL, TRYING TO SUPPORT FO AND NOT TAKE THE ACFT OR TAKE US OUT OF SEQUENCE SINCE MANY PAX HAD TIGHT INTL CONNECTIONS (ALREADY 30 MINS LATE). THAT WAS THE CAPT'S MISTAKE, ALTHOUGH WE PULLED IT OUT THIS TIME. BUT BOY, IT WAS NOT PRETTY!! CAPT AND FO WERE BOTH UNDER 100 HRS AND NEW TO JET -- PLAYED SOME PART IN EVENTS DESCRIBED.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
347848	analyst 1	6	7	6	5	6	5
	analyst 2	5	5	5	6	6	5
	analyst 3	6	6	5	6	6	7

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 5. Narrative of ASRS incident report number 347848, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

349669
I UNDERSTAND THAT YOUR JURISDICTION MORE THAN LIKELY DOES NOT INCLUDE NICARAGUA, HOWEVER, I BELIEVE THIS WAS A CLASSIC SIT OF A FOREIGN ATC LANGUAGE BARRIER. THE WX AROUND MANAGUA WAS APPROX 1500 FT OVCST AND 10 MI, TSTMS SURROUNDING THE FIELD AND AT THE FIELD ITSELF. THE RIDE ON THE DSCNT WAS NOTHING MORE THAN LIGHT TURB WITH VERY OCCASIONAL MODERATE CHOP AND MODERATE RAIN. I HAD PROGRAMMED THE FMC TO PLAN ON A DSCNT TO ARRIVE 35 NM FROM MANAGUA AT 10000 FT MSL AND 250 KTS. WE WERE ON FLT PLAN AIRWAY A502 TO MANAGUA. AS THE FO AND MYSELF LOOKED AT THE APCH PLATE WE NOTICED THAT THERE WERE 1 OF 2 WAYS TO EXECUTE THE VOR RWY 9 APCH. HE HAD MENTIONED TO ME THAT HE HAD ALWAYS USED THE PROC OF INTERCEPTING THE PUBLISHED 10 DME ARC AND UTILIZING THAT METHOD TO RWY 9. AS I HAD NEVER BEEN TO MANAGUA BEFORE AND NOTING THE PRESENCE OF AIRWAY A502 DEPICTED ON THE CHART AS THE START POINT OF THE 10 DME ARC I AGREED THAT THIS WAS PROBABLY WHAT WE WOULD GET. LET ME NOTE THAT MANAGUA IS A NON RADAR APCH CTL ENVIRONMENT. THE CTLR PROCEEDED TO STEP US DOWN FROM 11000 FT MSL TO 5000 FT MSL. PRIOR TO THE TURN OFF OF THE AIRWAY TO INITIATE THE 10 DME ARC SHE SAID 'RPT 5 DME RWY 9.' THERE WAS NO STATEMENT FROM THE CTLR TO 'EXPECT APCH CLRNC AT THE VOR,' 'CROSS THE VOR AT 5000 FT, RPT 5 DME,' 'CROSS THE VOR AT 5000 FT, CLRED FOR THE APCH.' ONLY 'RPT 5 DME RWY 9.' WE BOTH ASSUMED WRONGLY THAT SHE HAD MEANT RPT 5 DME OUT ON FINAL ON THE APCH TO RWY 9. SO WE COMMENCED FLYING THE ARC, TRANSITIONING FROM THE AIRWAY AND COMPLYING WITH THE CHARTED STEPDOWN FIXES ASSOCIATED WITH THE VOR 9 APCH. AS WE WERE TURNING FINAL AT APPROX 9 DME FROM THE RWY THE CTLR ASKED OUR POS AND ALT. WE RESPONDED WITH, 'ON FINAL, 9 DME AT 2700 FT AS PUBLISHED.' SHE THEN SAID THAT WE WERE TO HAVE CALLED 5 DME FROM THE VOR AND CROSSED THE VOR AT 5000 FT. THERE WAS NO OTHER TFC IN THE AREA. WE LANDED WITHOUT ANY INCIDENT AND THE CTLR NEVER QUESTIONED FURTHER. WE WERE HANDED OFF TO TWR AND GND CTL AND NOTHING MORE WAS MENTIONED AT ALL. IN FURTHER CONVERSATION BTWN THE FO AND MYSELF WE BOTH CAME TO THE SAME CONCLUSION THAT ALL THAT WOULD HAVE HAD TO HAVE BEEN SAID WAS 'CROSS THE VOR AT 5000 FT, RPT 5 DME AND CLRED FOR THE APCH,' OR 'CLRED DIRECT TO THE MANAGUA VOR, MAINTAIN 5000 FT, AND RPT 5 DME.' WE ARE NOT PLACING BLAME ON ANYONE IN PARTICULAR AS I BELIEVE ALL OF US WERE TO FAULT TO A POINT. JUST SIMPLE MISCOM.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
349669	analyst 1	6	6	5	5	5	5
	analyst 2	7	6	6	6	6	6
	analyst 3	5	6	7	5	7	6

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 6. Narrative of ASRS incident report number 349669, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

363536
WE WERE ON A VECTOR FOR FINAL APCH COURSE TO ILS 3 AT CPR. DUE TO OUR HIGH ALT THE CTLR VECTORED US ACROSS FINAL ON A NE HDG. ACFT ANTI-ICE SYS WERE OPERATIVE AND SPD BRAKES WERE DEPLOYED TO KEEP AIRSPD BELOW 250 KIAS IN DSCNT. WE WERE CLRED TO DSND TO 7400 FT MSL. CTLR GAVE US A VECTOR TOWARDS THE S, R TURN IN ORDER TO MANEUVER US AROUND TO REINTERCEPT FINAL. SHORTLY AFTER THIS THE GPWS ALERTED US TO 'TERRAIN, TERRAIN.' AN IMMEDIATE CLB WAS INITIATED AND THE ACFT WAS SUBSEQUENTLY LANDED SAFELY. CONTRIBUTING FACTORS: 1) CTLR VECTORED US AT AN ALT BELOW MVA. 2) POOR SITUATIONAL AWARENESS BY FLC. 3) CREW DISTR BY CONVECTIVE ACTIVITY IN AREA AND ICING. 4) TOO MUCH TRUST PUT IN CTLR BY FLC. CALLBACK CONVERSATION WITH RPTR REVEALED THE FOLLOWING INFO: RPTR CALLED BACK WITH THE FOLLOWING: THE FLC BRIEFING WAS DONE BUT IT WAS ACCOMPLISHED ALONG WITH THE DSCNT CHKLIST DURING THE APCH AND VECTOR FROM OVER THE ARPT. THIS ACR DOES NOT USE ANY TERRAIN AWARENESS IN THEIR APCH BRIEFINGS. RPTR WAS COUNSELED REGARDING THIS. FO ADMITS TO IT BEING VERY MUCH OF A RUSHED ATMOSPHERE AND ADMITS TO A LOSS OF SITUATIONAL AWARENESS IN EVENT. THE FMS ON THE ACFT WAS NOT BEING USED. APCH PLATES WERE OUT AND USED. THE RADIO ALTIMETER WAS NOT READ DURING THE GPWS. ZDV KEPT FLT HIGH AND THAT STARTED THE EVENT WITH A DELAY VECTOR BEING NEEDED. RPTR REMEMBERS THAT INITIALLY THE CTLR WANTED TO TURN THEM L WHILE ON THE OVERHEAD -- NE VECTOR PRIOR TO THE TURN TO THE S, BUT THIS WAS REFUSED ACCOUNT TSTM ACTIVITY TO THE L, N. THE TURN S WAS MADE AT A STANDARD RATE 25 DEG BANK ANGLE. CREW DID NOT FEEL THAT THEY WANTED TO CALL THE CTLR ON THE GND WHO, IT WAS THOUGHT, WAS WORKING A SPLIT POS OF APCH, TWR AND GND.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
363536	analyst 1	6	6	6	6	5	5
	analyst 2	6	6	7	7	6	6
	analyst 3	7	7	7	7	7	7

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 7. Narrative of ASRS incident report number 363536, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

310143
ATC CLRNCS AND HIGH TERRAIN IN SOUTH AMERICA. WE WERE FLYING INTO CALL COLUMBIA WHEN ATC CLRED US DIRECT TO THE CALI VOR AND DSND TO 5000 FT. CALI HAS A STAR AND HIGH TERRAIN OF EITHER SIDE OF THE STAR ROUTING. WHEN I CHKED THE POINTS ON THE STAR AGAINST OUR CURRENT DIRECT THE VOR RTE OF FLT IT LOOKED LIKE WE WOULD BE VERY CLOSE TO THE STAR ROUTING. WHEN YOU ARE 200 MI OUT, A 15 MI DIFFERENCE IS BARELY NOTICEABLE. FURTHER CHKING OF THE AREA CHART AND OUR DIRECT THE VOR ROUTING SHOWED TERRAIN AT 14000 FT TO 11000 FT DIRECTLY ALONG OUR PATH. A SIMILAR ATC CLRNC HAPPENS VERY OFTEN FLYING INTO LIMA, PERU. MANY, MANY, MANY PLTS ARE NOT AWARE OF JUST HOW CRUCIAL IT IS NOT TO ACCEPT THESE DEADLY CLRNCS. PLEASE GET THE WORD OUT AGAIN.

Note: In the first sentence of the narrative, the words "CALL COLUMBIA" (referring to Cali, Colombia) are shown as they appear in the ASRS database.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
310143	analyst 1	5	3	5	2	3	3
	analyst 2	7	7	7	7	7	7
	analyst 3	7	7	7	2	7	7

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 8. Narrative of ASRS incident report number 310143, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

310228
VERY LATE NIGHT APCH TO BOSTON LOGAN. WE DECIDED TO FLY THE APCH TO RWY 33L USING OUR NEW APCH NAV PROCS. THE ATIS WAS SAYING TO EXPECT THE VOR/DME GPS RWY 33L. WE PULLED UP THIS APCH FROM OUR COMPUTER DATABASE AND INSERTED IT. UPON CHKING ON WITH BOS APCH WE REQUESTED THE VOR/DME RWY 33L WITH A TURN ON JUST OUTSIDE YARDD. APCH SAID OK AND GAVE US A HDG. WHEN TURNED ON A BASE APCH, TOLD US WE WERE 5 MI FROM BEEJE AND CLRED FOR THE VOR/DME GPS RWY 33L. UNBEKNOWNST TO US THERE ARE 2 APCHS, ONE NAMED THE (GPS) VOR/DME RWY 33L AND THE OTHER NAMED VOR DME OR GPS A. WE UNDERSTOOD THE CLRNC TO BE FOR THE (GPS) VOR DME RWY 33L WHICH HAS AN INBOUND COURSE OF 342 DEGS, WHILE THE APCH CTLR UNDERSTOOD THE CLRNC TO BE FOR THE VOR DME OR GPS A APCH WHICH HAS AN INBOUND COURSE OF 310 DEGS. SINCE WE WERE LOOKING TO INTERCEPT THE 342 DEG COURSE WE OVERSHOT THE 310 DEG COURSE. TWR TOLD US WE WERE L OF COURSE, AT WHICH TIME WE RPTED FIELD IN SIGHT AND PROCEEDED FOR THE VISUAL APCH. ONE FURTHER POINT OF CONFUSION: THE FINAL APCH FIX FOR THE VOR DME OR GPS-A APCH IS BEEJE AND THE FAF FOR THE (GPS) VOR DME RWY 33L IS MEACH. THESE SOUND VERY SIMILAR AND COMBINED WITH THE ALMOST IDENTICAL APCH NAMES CREATES A STRONG POTENTIAL FOR CONFUSION. AT LEAST THE APCHS SHOULD BE RENAMED AND PROBABLY THE FAF'S AS WELL. SUPPLEMENTAL INFORMATION FROM ACN 310132: I BRIEFED AN 'APCH NAV' (RNAV) VOR/DME RWY 33L APCH AND INSERTED IT INTO THE FMGC. THE FO TOLD APCH THAT WE WOULD LIKE TO INTERCEPT THE FINAL OUTSIDE 'YARDD' (ON THE VOR/DME APCH TO RWY 33L). APCH CTL STATED FINE, WHATEVER WE WANTED. THIS WOULD FACILITATE CAPTURING APPR- NAV. WE WERE ASKED LATER ABOUT THE LENGTH OF FINAL WE DESIRED AND AGAIN REQUESTED 'OUTSIDE OF YARDD.' THIS IS FOUND ONLY ON THE (GPS) VOR/DME RWY 33L APCH PLATE. APCH TURNED US ONTO A BASE LEG OF 290 DEGS AND SAID '5 MI TO BEEJE CLRED VOR/DME OR GPS-A 33L APCH.' WE MISSED THE 'ALPHA' AND THE REST OF THE CLRNC SOUNDED LIKE WHAT WE WERE EXPECTING AND LOADED THE FMGC. YARDD IS NOT ON THE VOR/DME OR GPS-A APCH AND THE FAF MEACH SOUNDS A LOT LIKE BEEJE. PASSING THROUGH THE 310 DEG FINAL COURSE FOR THE VOR/DME OR GPS-A APCH TRYING TO INTERCEPT THE 342 DEG FINAL COURSE FOR THE VOR/DME 33L APCH, TWR TOLD US WE HAD FLOWN THROUGH FINAL AND SENT US BACK TO APCH. WE SUBSEQUENTLY RPTED THE ARPT AND RWY IN SIGHT AND WERE CLRED A VISUAL APCH. WE LANDED WITHOUT CONFLICT OR INCIDENT. (TOO LATE TO RELOAD ANOTHER APCH IN THE FMGC.)

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
310228	analyst 1	3	3	3	3	3	2
	analyst 2	6	6	6	6	7	6
	analyst 3	7	6	6	6	6	6

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 9. Narrative of ASRS incident report number 310228, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

223467

DEP LGA DEP CTL ALTERED RTE TO DIRECT COL, DIRECT WHITE AF VICE RV WHITE. FO ENTERED COL INTO FMS NAV SYS AND BEGAN FOLLOWING COURSE INFO. COL IN DATA BASE OF FMS WAS LATER FOUND TO BE COLIMA MEX VOR AND NOT COL COLTS NECK. DEP CTL QUESTIONED 260 DEG HDG FOR COLTS NECK. FO SELECTED #2 VOR 115.4 AND FOUND VOR NEEDLE TURNING AND 000 DME AND STARTED TURN 204 DEG TO WHITE. AGAIN DEP CTL QUESTIONED OUR HDG AND RECLRED US DIRECT COL-WHITE. CAPT SELECTED #1 VOR COL 115.4 AND FOUND IT TO BE 125 DEG TO COL. SO FO USED #1 VOR COL 115.4 AND FOUND IT TO BE 125 DEG TO COL. SO FO USED VOR #1 AND FLEW DIRECT COL AS FILED. INVESTIGATION REVEALED FMS DATA BASE COL TO COLIMA MEX VOR. #2 DME INOP WITHOUT ANY AT FLAG. AFTER WE FOUND FO DME INDICATOR TO READ 000 DME ALL TIMES. ALL VOR REC AND DME ON CAPT SIDE WORK NORMALLY. UPON ARR FLL ON FLT X, I, THE CAPT, CALLED CHIEF PLTS OFFICE IN ATLANTA AND ADVISED THEM OF THE BEFORE MENTIONED. CAPT X OF THE CHIEF PLT'S OFFICE CALLED ENGINEERING FOR FLT GUIDANCE. ITEM #122 IN OUR DATA BASE WAS COL, COLIMA MEX VOR AND NOT COL FOR COLTS NECK, ABOUT 1900 NM AND MANY MANY DEG OFF COURSE. I HAVE NOW FOUND OUT THAT MY COMPANY WILL NOT AND DOES NOT GUARANTEE ANY INFO IN THE FMS DATA BANK TO BE CORRECT. I MUST INSURE VIA THE LAT/LONG FROM A COMPANY MAP THAT THEY ARE CORRECT. THIS SYS WILL NOT AND DOES NOT WITH ENRTE, RTE CHANGES. SO WELCOME TO THE BACK SIDE OF THE ELECTRONIC WORLD, USE AT YOUR RISK OR LEAVE ALONE. WE HAVE 3 INS AND 1 FMS PER WDB. ABOUT 880000 DOLLARS PER PLANE. CALLBACK CONVERSATION WITH RPTR REVEALED THE FOLLOWING INFO. THE RPTING CAPT IN THIS INCIDENT IS RATHER EMBARRASSED ABOUT THE REACTION THAT HE GOT FROM HIS COMPANY WHEN HE TOLD MGMNT ABOUT HIS PROBLEM -- THE PROBLEM BEING THAT COL (COLIMA, MEX) COMES UP ON THE FMC WHEN ONE ASKS FOR COL (COLTS NECK, NJ). BOTH COLS SHOULD COME UP, OFFERING THE PLT A CHOICE OF MEXICO OR NEW JERSEY OR ANY OTHER COL ON THE PLANET. HIS FLT MGR TRIED TO GET THE COMPANY ENGINEERING TO CHANGE THE DATA BASE, BUT NOTHING HAS BEEN DONE IN 3 WKS. NO ALTERING OR WARNING MESSAGE HAS BEEN PUT ON THE FLT PLANS ABOUT THIS ANOMALY. EACH CREW MUST CHK LAT/LONG AGAINST THE FLT PLAN AND THE COMMERCIAL CHART BEFORE DEP. THIS IS FINE, BUT WHY SPEND 1000000 DOLLARS/ACFT, AND THEN HAVE TO DO ALL OF THIS?

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
223467	analyst 1	6	6	6	6	5	5
	analyst 2	2	6	6	4	6	6
	analyst 3	5	6	7	6	7	6

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 4. Figure 10. Narrative of ASRS incident report number 223467, one of the narratives rated as highly relevant to the Cali accident. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

Appendix 5.

Examples of incidents about which the analysts disagree

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310228
VERY LATE NIGHT APCH TO BOSTON LOGAN. WE DECIDED TO FLY THE APCH TO RWY 33L USING OUR NEW APCH NAV PROCS. THE ATIS WAS SAYING TO EXPECT THE VOR/DME GPS RWY 33L. WE PULLED UP THIS APCH FROM OUR COMPUTER DATABASE AND INSERTED IT. UPON CHKING ON WITH BOS APCH WE REQUESTED THE VOR/DME RWY 33L WITH A TURN ON JUST OUTSIDE YARDD. APCH SAID OK AND GAVE US A HDG. WHEN TURNED ON A BASE APCH, TOLD US WE WERE 5 MI FROM BEEJE AND CLRED FOR THE VOR/DME GPS RWY 33L. UNBEKNOWNST TO US THERE ARE 2 APCHS, ONE NAMED THE (GPS) VOR/DME RWY 33L AND THE OTHER NAMED VOR DME OR GPS A. WE UNDERSTOOD THE CLRNC TO BE FOR THE (GPS) VOR DME RWY 33L WHICH HAS AN INBOUND COURSE OF 342 DEGS, WHILE THE APCH CTLR UNDERSTOOD THE CLRNC TO BE FOR THE VOR DME OR GPS A APCH WHICH HAS AN INBOUND COURSE OF 310 DEGS. SINCE WE WERE LOOKING TO INTERCEPT THE 342 DEG COURSE WE OVERSHOT THE 310 DEG COURSE. TWR TOLD US WE WERE L OF COURSE, AT WHICH TIME WE RPTED FIELD IN SIGHT AND PROCEEDED FOR THE VISUAL APCH. ONE FURTHER POINT OF CONFUSION: THE FINAL APCH FIX FOR THE VOR DME OR GPS-A APCH IS BEEJE AND THE FAF FOR THE (GPS) VOR DME RWY 33L IS MEACH. THESE SOUND VERY SIMILAR AND COMBINED WITH THE ALMOST IDENTICAL APCH NAMES CREATES A STRONG POTENTIAL FOR CONFUSION. AT LEAST THE APCHS SHOULD BE RENAMED AND PROBABLY THE FAF'S AS WELL. SUPPLEMENTAL INFORMATION FROM ACN 310132: I BRIEFED AN 'APCH NAV' (RNAV) VOR/DME RWY 33L APCH AND INSERTED IT INTO THE FMGC. THE FO TOLD APCH THAT WE WOULD LIKE TO INTERCEPT THE FINAL OUTSIDE 'YARDD' (ON THE VOR/DME APCH TO RWY 33L). APCH CTL STATED FINE, WHATEVER WE WANTED. THIS WOULD FACILITATE CAPTURING APPR- NAV. WE WERE ASKED LATER ABOUT THE LENGTH OF FINAL WE DESIRED AND AGAIN REQUESTED 'OUTSIDE OF YARDD.' THIS IS FOUND ONLY ON THE (GPS) VOR/DME RWY 33L APCH PLATE. APCH TURNED US ONTO A BASE LEG OF 290 DEGS AND SAID '5 MI TO BEEJE CLRED VOR/DME OR GPS-A 33L APCH.' WE MISSED THE 'ALPHA' AND THE REST OF THE CLRNC SOUNDED LIKE WHAT WE WERE EXPECTING AND LOADED THE FMGC. YARDD IS NOT ON THE VOR/DME OR GPS-A APCH AND THE FAF MEACH SOUNDS A LOT LIKE BEEJE. PASSING THROUGH THE 310 DEG FINAL COURSE FOR THE VOR/DME OR GPS-A APCH TRYING TO INTERCEPT THE 342 DEG FINAL COURSE FOR THE VOR/DME 33L APCH, TWR TOLD US WE HAD FLOWN THROUGH FINAL AND SENT US BACK TO APCH. WE SUBSEQUENTLY RPTED THE ARPT AND RWY IN SIGHT AND WERE CLRED A VISUAL APCH. WE LANDED WITHOUT CONFLICT OR INCIDENT. (TOO LATE TO RELOAD ANOTHER APCH IN THE FMGC.)

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
310228	analyst 1	3	3	3	3	3	2
	analyst 2	6	6	6	6	7	6
	analyst 3	7	6	6	6	6	6

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 5. Figure 1. Narrative of ASRS incident report number 310228, one of the narratives rated as relevant to the Cali accident by two of the analysts, but not rated as relevant by the other analyst. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

140711
AFTER PASSING KILER (N15:00.0 W 76:52.0), BARRANQUILLA CTL CLRED US DIRECT TULUA VOR. AS WE WERE PASSING ABEAM CARTAGENA VOR, AN LGT Y CROSSED OUR NOSE HDG IN A NE DIRECTION. IT WAS EXTREMELY CLOSE AND WE ARE SURE HE WAS AT OUR ALT BECAUSE WE HIT HIS WAKE TURBULENCE AS WE PASSED BEHIND HIM. BARRANQUILLA CTL STATED THAT HE WAS CTLING NO OTHER ACFT IN OUR AREA AT FL330. IN THE FUTURE, I WILL NOT ACCEPT AN OFF AIRWAYS CLRNC WHEN NOT POSITIVE OF BEING IN RADAR CONTACT. CTLR STATED THAT SOMETIMES ACFT TRANSVERSE HIS AIRSPACE THAT HE WAS NOT CTLING. ALSO, BARRANQUILLA RADIO VERY WEAK AND UNCLEAR. I NORMALLY FLY WITH THE RWY TURNOFF LIGHTS ON AT ALL TIMES AND WAS ONCE CRITICIZED BY A COMPANY CHECK PLT FOR THIS PRACTICE. ON THIS PARTICULAR DAY, MY RIGHT TURNOFF BURNED OUT AND POPPED ITS CIRCUIT BREAKER. THE CONFLICTING TFC CAME FROM THE DIRECTION OF THE SETTING SUN SO HIS CHANCES OF SEEING US WAS MUCH GREATER THAN US SEEING HIM. AFTER I MADE MY NEAR MISS REPORT TO BARRANQUILLA CTL, THERE WAS A LOT OF JABBERING IN SPANISH BETWEEN BARRANQUILLA AND OTHER ACFT. I BELIEVE SOMEONE IS COVERING UP A MISTAKE. WE HAD BEEN ASKED TO SQUAWK A XPONDER CODE LONG BEFORE THE NEAR MISS SO WE ASSUMED WE WERE BEING PROVIDED RADAR SEPARATION. NOW, I'M NOT SO SURE. MY SUGGESTION TO OTHER PLTS WHO FLY SOB (SOUTH OF THE BORDER) IS TO USE ANY MEANS AVAILABLE TO AVOID A SIMILAR SITUATION. SOME SUGGESTIONS ARE USE OF EXTERIOR LIGHTS, FLYING 100' ABOVE OR BELOW ASSIGNED FLT LEVEL, NOT FLYING OFF AIRWAY DIRECT ROUTES, AND OF COURSE EXTREME VIGILANCE. SUPPLEMENTAL INFORMATION FROM ACN 140497: BAQ CTL HAD NO KNOWLEDGE OF THE CONFLICTING ACFT, ONLY REPORTED TFC WAS AT FL310.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
140711	analyst 1	5	5	6	6	5	5
	analyst 2	1	1	1	1	1	1
	analyst 3	5	5	6	6	6	6

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 5. Figure 2. Narrative of ASRS incident report number 140711, one of the narratives rated as relevant to the Cali accident by two of the analysts, but not rated as relevant by the other analyst. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

153355
F/O WAS FLYING THE CHINS ONE ARR INTO SEATAC USING THE FMS FOR PRIMARY NAV. THE FMS DISPLAY WAS SELECTED AND SHOWED US TO BE ON COURSE. BOTH THE B AUTOPLT WITH FMS SELECTED IN THE NAV MODE AND AUTOTHROTTLES WERE SELECTED AND ENGAGED. APPROX 40 NM +/- SE OF SEA VOR, APCH CTL TOLD US THAT HIS RADAR SHOWED US TO BE +/- 3 MI N OF COURSE. APCH CTL GAVE US A L TURN VECTOR TO RETURN TO COURSE. A CHK OF THE SEA VOR R SHOWED THAT EVEN THOUGH FMS SHOWED CTRED ON COURSE IT WAS IN ERROR. APCH CTL DID NOT REQUEST THAT WE INTERCEPT THE ARR AND THE XED THROUGH THE ARR R (SEA 101 DEG). APCH CTL THEN GAVE US A R TURN VECTOR AND WE BELIEVED THAT WE WERE THEN NOT ON THE PUBLISHED ARR. IN FACT THE F/O REMARKED THAT WE MUST BE IN AN APCH CTL VECTOR FOR A W DOWNWIND FOR A S LNDG AT SEATAC. THEREFORE, WE DID NOT MAKE THE PUBLISHED TURN TO 340 DEG. SUBSEQUENT COMMENTS FROM APCH SUGGESTED THAT THIS WAS NOT UNCOMMON INDICATING PROBS WITH THIS ARR.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
153355	analyst 1	6	5	5	6	5	5
	analyst 2	4	5	5	4	5	5
	analyst 3	3	3	2	1	2	2

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 5. Figure 3. Narrative of ASRS incident report number 153355, one of the narratives rated as relevant to the Cali accident by two of the analysts, but not rated as relevant by the other analyst. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

355364
ON DSCNT TO 3200 FT MSL (MVA) AT APPROX 3400 FT, WE RECEIVED A GPWS WARNING 'TOO LOW, TERRAIN.' FLC IMMEDIATELY PERFORMED ESCAPE MANEUVER. AT APPROX 3800-3900 FT, AND IN VMC, WE STARTED OUR DSCNT BACK DOWN TO 3200 FT AND INFORMED APCH CTL OF OUR SIT. ACFT RATE OF DSCNT WAS APPROX 700 FPM. WE BELIEVE THAT EVEN THOUGH WE WERE ABOVE MVA, THE COMBINATION OF RISING TERRAIN AND ACFT DSCNT RATE MAY HAVE CAUSED THE GPWS TO GIVE ITS WARNING. RADAR ALT WAS 1600-1800 FT AGL AT TIME OF WARNING.

Analysts' ratings of each assertion of relevance

report number	analyst	A: similar context	B: similar events	C: similar problems	D: similar human factors	E: similar causes	F: unspecified relevance
355364	analyst 1	3	2	2	3	2	2
	analyst 2	3	5	2	3	2	3
	analyst 3	3	3	2	1	2	2

(1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: undecided, 5: somewhat agree, 6: agree, 7: strongly agree)

Appendix 5. Figure 4. Narrative of ASRS incident report number 355364, one of the narratives rated as irrelevant to the Cali accident by two of the analysts, but rated as relevant by the other analyst. Also shown are the analysts' ratings of the six assertions of relevance, as they apply to this narrative.

Appendix 6.

Excerpts of each of the 84 relevant incidents,
categorized by prominent features they share with the Cali accident

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Appendix 6. Excerpts of each of the 84 relevant incidents, categorized by prominent features they share with the Cali accident. In summary, among the 84 incidents rated as relevant by QUORUM and also rated as relevant by one or more of the analysts: 37 incidents involved over-reliance on automation, and other problems with the use of automation; 29 incidents involved confusion, changes, and problems during descent/approach; 19 incidents involved terrain avoidance; and 6 incidents involved operations in foreign airspace. The number of incidents under each heading appears in parentheses at the end of each header. The numbers sum to 91 because five of the incidents appear in two different places, and another one appears in three places. Because of these and other cases of categorical overlap, the numbers in the headings should not be over-interpreted. Clearly, the categories cannot be logically distinct because the use of automation and the occurrence of incidents during descent/approach are pervasive, and other features are also shared. Accordingly, assignments to categories are based on the more prominent features of the incidents that are shared with the Cali accident. As used here, the term "automation" refers to the FMS (flight management system) or other components of the automated flight systems that are used to operate the aircraft.

1. Over-reliance on automation, and other problems with use of automation (37)

1.1. Over-reliance on automation (36)

Incidents involving over-reliance on automation typically also involved course or altitude deviations. Such deviations imply a loss of situational awareness on the part of the crew.

1.1.1. Automation turns aircraft off course (5)

Incidents 223467 and 224363 not only involved automation turning the aircraft off course, but also involved confusion of identical names in the FMS leading to course deviations.

223467 DEP LGA DEP CTL ALTERED RTE TO DIRECT COL...FO ENTERED COL INTO FMS NAV SYS AND BEGAN FOLLOWING COURSE INFO. COL IN DATA BASE OF FMS WAS LATER FOUND TO BE COLIMA MEX [i.e., Mexico] VOR AND NOT COL COLTS NECK [New Jersey]. DEP CTL QUESTIONED 260 DEG HDG FOR COLTS NECK....I HAVE NOW FOUND OUT THAT MY COMPANY WILL NOT AND DOES NOT GUARANTEE ANY INFO IN THE FMS DATA BANK TO BE CORRECT. I MUST INSURE VIA THE LAT/LONG FROM A COMPANY MAP THAT THEY ARE CORRECT. [also see 223467 in "1.1.4. Name confusion using automation"]

224363 UPON DEP, LGA DEP CTL ALTERED RTING TO DIRECT COL...FO ENTERED COL IDENTIFIER INTO FMS NAV SYS AND BEGAN FOLLOWING COURSE INFO. COL IN DATA BANK OF FMS WAS LATER VERIFIED 1900 MI FROM COL. DEP CTLR QUESTIONED 260 DEG HDG FOR COLTS NECK....THIS RPT SEEMS TO BE A MATCH OF A PREVIOUS PROBLEM WITH COLTS NECK/COLIMA HAVING THE SAME IDENTIFIER, COL THE RPTR IN THIS INCIDENT STATES THAT THE ANOMALY IS STILL IN THE DATA BASE....THIS RPTR STATES THAT THERE ARE OTHER HOLES IN THE DATA BASE, SPECIFICALLY INCLUDING THE NANCI 4 ARR INTO LGA AND THE DARBS 1 ARR INTO TPA. HE PROMISES TO CONTINUE TO FIGHT TO IMPROVE THE DATA BASE. [also see 224363 in "1.1.4. Name confusion using automation"]

Incident 146645 not only involved automation turning the aircraft off course, but also involved effects of changes during descent/approach, confusion regarding charts, and erroneous data entry.

146645 I TUNED AND SET THE NAV EQUIP FOR THE ILS TO RWY 32 AND ANNOUNCED THAT THE APCH CHK WAS COMPLETE.... HOWEVER, OUR POS AND HDG RELATIVE TO THE LOC WAS LOOKING LIKE AN EXTREMELY TIGHT TURN ON OR AN OVERSHOOT, SO I REQUESTED OUR CURRENT HDG AND ALT ASSIGNMENT FROM APCH. WHAT WE RECEIVED WAS A TURN AND CLRNC FOR THE NDB APCH RWY 30 CIRCLE TO LAND RWY 32 AT STP AND TO CONTACT ST PAUL TWR. WHILE HURRYING TO GET THE NAV EQUIP RETUNED AND IDENTED AND RECONFIGURING THE ACFT I WENT RIGHT BY THE NDB RWY 30 CHART AND TOOK THE DATA FROM THE NDB RWY 3 ST PAUL, MN, LAKE ELMO. AS WE WENT BY THE NDB AND STARTED TO TURN TO THE INBND HDG, SOME 70 DEG FROM OUR CURRENT HDG, WE KNEW SOMETHING WAS WRONG. A QUICK CHK OF THE CHART CONFIRMED THE ERROR I HAD MADE. ... THE TWR CALLED AND SAID APCH SHOWED US NE OF COURSE. ... WE, AS A FLT CREW, SHOULD NOT HAVE ACCEPTED THE CLRNC FOR AN APCH TO A RWY DIFFERENT FROM THE ONE WE WERE SET UP FOR, UNLESS WE WERE SURE WE HAD TIME TO SET UP AND CONFIGURE FOR THE APCH TO THE NEW RWY. [also see 146645 in "2.2.2. Confusion regarding charts" and "2.1. Last minute approach/runway change leads to significant confusion"]

Incident 347848 not only involved automation turning the aircraft off course, but also involved loss of data when other data are entered.

347848 CAPT ... WAS OCCUPIED IN COMPLETING APCH SETUP IN FMS... . SEQUENCE IN FMS PROGRAMMING WAS SELECTING RWY 25L, LNAV DIRECT DOWNE, THEN BACK TO DEP/ARR PAGE TO RESELECT RWY 25L, CIVET, ARNES

TRANSITION. THIS DROPPED DOWNE AS ACTIVE WAYPOINT, AND STARTED JET IN TURN BACK TO ARNES. [also see 347848 in "1.1.2. Loss of data when other data are entered "]

353338 THE CAPT HAD BRIEFED A VISUAL APCH TO RWY 36L WITH AN RNAV RWY 36L APCH BACKUP. HE HAD ENTERED THE RNAV APCH INTO OUR FMS AND COUPLED THE FMS TO THE AUTOPLT WHICH WAS FLYING THE ACFT. WHEN WE CROSSED THE LEESE FIX THE AUTOPLT TURNED R AND HEADED FOR THE 'CAMBE' INTXN WHICH WAS THE INITIAL APCH FIX FOR THE RNAV RWY 36L APCH. ... THE FMS, COUPLED TO THE AUTOPLT IN THE NAV MODE, WAS DOING EXACTLY AS THE CAPT HAD PROGRAMMED IT, SO HE DID NOT SUSPECT A PROB. ... CTLR ASKED WHERE DID YOU GET THAT HDG? ... THE CTLR HAD EXPECTED THEM TO CONTINUE ON TO THE VOR AS SHOWN ON THE ARR CHART.

1.1.2. Loss of data when other data are entered (5)

272508 WHAT I FAILED TO NOTICE WAS THAT BY INSERTING THE ARR IN THE FMS, THE COMPUTER DUMPED THE XING RESTRICTION I HAD INSERTED JUST A FEW MOMENTS EARLIER. ... THE CAUSE, I BELIEVE, WAS A COMBINATION OF COCKPIT MGMNT OVERLOAD DURING THE APCH PHASE COUPLED WITH AN OVERCONFIDENCE IN THE FMS TO PRESENT VALID DSCNT PROFILE INFO. I ALLOWED MYSELF TO GET TOO BUSY DURING THE DSCNT TO MAKE ESSENTIAL XCHKS TO CONFIRM THE FMS WAS WORKING AS ADVERTISED.

279030 IN ENTERING THE [ILS approach] DATA INTO THE DATABASE, WE WERE UNAWARE THAT THE 15000 FT CONSTRAINT AT MUMSY WAS DELETED. THEREFORE, THE ACFT HAD REVERTED TO A 1000 FPM RATE OF DSCNT. WE REALIZED THE ERROR AS WE WERE XING OVER MUMSY AT ABOUT 18000 FT.

361956 DURING DSCNT TO BRONC INTXN...I ENTERED THE LNDG RWY 33L INTO THE FMS. THIS CAUSED THE RESTR AT BRONC (280 KTS/11000 FT) TO DELETE ITSELF. I HAD THE ACFT SELECTED TO MANAGED FLT AND DID NOT OBSERVE THAT IT CHANGED TO VERT SPD AND THE RESTR DELETED. CTR REALIZED THAT WE PROBABLY WOULD NOT MAKE THE RESTR AND GAVE US A VECTOR. ... THIS WOULD NOT OCCUR IF ONCE A RESTR WAS PLT ENTERED INTO THE FMS IT WOULD NOT AUTOMATICALLY DELETE ITSELF WHEN A DEST RWY IS ENTERED.

Incident 275413 also involved problems due to changes late in descent/approach.

275413 AT THIS POINT, TO COMPLY WITH THE 210 KIAS SPD REQUEST BY ATC, THE FO SELECTED THE 'VERT SPD' FUNCTION ON THE DIGITAL FLT GUIDANCE PANEL, SETTING 600 FPM DSCNT RATE AND CHANGING THE 'SPD SELECT' WINDOW TO SHOW 210 KTS. BECAUSE OF A FLAW IN THE MD-88'S DIGITAL FLT GUIDANCE PROGRAM, LAST SECOND CHANGES IN ANY OF THE VERT CTL FUNCTIONS WILL REMOVE THE ALT LEVEL OFF COMMAND PREVIOUSLY SELECTED. THE ALT WARNING SIGNAL AND A TCASII 'TA' GOING OFF SIMULTANEOUSLY AT 7700 MSL BROUGHT OUR ATTN TO THE DEV. [also see 275413 in "2.4. Other problems with changes late in descent/approach"]

Incident 347848 also involved automation turning the aircraft off course.

347848 CAPT ... WAS OCCUPIED IN COMPLETING APCH SETUP IN FMS... . SEQUENCE IN FMS PROGRAMMING WAS SELECTING RWY 25L, LNAV DIRECT DOWNE, THEN BACK TO DEP/ARR PAGE TO RESELECT RWY 25L, CIVET, ARNES TRANSITION. THIS DROPPED DOWNE AS ACTIVE WAYPOINT, AND STARTED JET IN TURN BACK TO ARNES. [also see 347848 in "1.1.1. Automation turns aircraft off course"]

1.1.3. Distracted by automation (7)

Incident 368360 is one of the two incidents rated by all three analysts as highly relevant to the Cali accident. The other is 310130 in section 2.1. See appendix 3, table 1 for the list of incidents sorted on their relevance ratings.

368360 WE WERE AGAIN GIVEN INVALID ROUTING (RTE BREAK ON FMS). AT THIS POINT MY FO BECAME ENGROSSED IN LOOKING ON OUR HIGH AND LOW ALT ENRTE CHARTS TO FIND WHERE THE PROB WAS. I TRIED AGAIN TO ENTER ROUTING ON THE FMS (THIS TOOK APPROX 2 MINS). I LOOKED UP TO SEE MY FLT INSTS AND AT THIS TIME NOTED THE ALTIMETER READING FL312 AND CLBING. I IMMEDIATELY DISCONNECTED THE AUTOPLT... APPROX 5 SECONDS LATER ZBW TOLD US TO MAINTAIN FL310. ... I BELIEVE THAT THE COMPLEXITY OF FMS PROGRAMMING IS NOT ADDRESSED IN INITIAL TRAINING AT SCHOOL BECAUSE EACH ACFT HAS DIFFERENT EQUIP. HOWEVER, THIS LEAVES THE FLC TO 'LEARN AS THEY FLY.' THIS EFFECTIVELY TOOK MY FO OUT OF THE LOOP IN THAT IF HE WAS PROGRAMMING THE FMS, I COULD HAVE CONCENTRATED MORE ON MONITORING THE ACFT... THE ENTIRE CREW WAS DISTR, AND WE BOTH FAILED TO MONITOR THE PERFORMANCE OF THE ACFT.

359641 WE WERE NAVING USING FMS. WORKLOAD WAS HIGH FOR BOTH PLTS, AND THE FMS DID NOT APPEAR TO BE INTERCEPTING THE COURSE. NEITHER PLT NOTICED THE ALT PASSING 5000 FT. AT 5300 FT, THE ALT ALERTER

SOUNDED... THE MAJOR CAUSE OF THIS DEV WAS WHEN BOTH PLTS WERE DISTRACTED BY A MINOR FMS PROB DURING A BUSY DEP. THE PF SHOULD HAVE IGNORED THE FMS AND SWITCHED TO RAW DATA NAV.

160843 I CALLED THE APCH UP ON THE FMS AND REALIZED THAT THE APCH IN THE FMS DATA BASE DID NOT GIVE ANY PRECISE GUIDANCE TO THE APCH END OF THE RWY. I STARTED TO BUILD THE APCH... THE PREOCCUPATION OF BOTH CREW MEMBERS CAUSED A DELAY IN COMPLETION OF THE DSNT CHKLIST (USUALLY DONE PASSING THROUGH 18000') UNTIL JUST AFTER LEVEL OFF AT 11000'. WE RESET THE ALTIMETERS TO 30.22 AND REALIZED WE HAD LEVELED OFF AT 11300'.

219222 THE FO DID THE REQUIRED FMS ENTRIES. ENCOUNTERING DIFFICULTY WITH THE FORMAT FOR ENTRY MY ATTN WAS DIVERTED TO EXPLAIN THE FORMAT FOR FMS TO THE FO. UPON COMPLETION OF THE ENTRY THE DSCNT INFO WAS SLOW BEING DISPLAYED (AN UNFORTUNATE CHARACTERISTIC OF THE WDB ACFT FMS). MEANWHILE, MENTAL CALCULATIONS INDICATED THE XING RESTRICTION COULD NOT BE MADE... MY OWN INEXPERIENCE WITH THIS ACFT SIMPLY DID NOT ALERT ME TO THE DIFFICULTY IN COMPLYING WITH THE CLRNC WHEN FIRST ISSUED AND THE FMS FORMAT PROBLEM ENCOUNTERED BY THE FO ARE ALL TOO COMMON ON THIS ACFT... .

184380 I SHOULD HAVE MONITORED MORE CLOSELY ON HOW THE CAPT HAD LOADED THE FMS ON ARR. AFTER I FOUND THE DISCREPANCIES I BECAME OVERLOADED ON KEEPING UP ON WHAT THE CAPT WAS DOING AND WHAT WAS NEEDED TO CORRECTLY FLY THE APCH AND DO ALL THE CHKLIST ITEMS.

296506 WE LANDED ON RWY 9R. ... WE HAD NOT RECEIVED LNDG CLRNC FROM ATLANTA TWR. THIS EVENT COULD HAVE POSSIBLY BEEN AVOIDED IF THE CAPT HAD NOT BEEN PROGRAMMING THE FMS DURING THE APCH.

350190 AUTOPLT ENGAGED, THE ACFT ENTERED A POCKET OF SEVERE TURB. ... FO APPROPRIATELY DISCONNECTED AND MADE PROPER INPUTS MANUALLY. ... ONCE WE STABILIZED AT 16000 FT, I WAS THEN REQUIRED TO MAKE AMENDMENTS TO THE FMS FOR THE APCH AND BRIEF THE APCH. DUE TO THESE DESCRIBED FACTORS, I FORGOT TO RPT THE TURB.

1.1.4. Name confusion using automation (4)

(Also see section "2.2.1. Name confusion" in section "2.2. Other confusion during descent/approach.")

The Cali accident involved two distinct instances of name confusion. First, the arrival was named ROZO 1, instead of TULUA 1, which appeared to confuse the captain. According to the NTSB report (NTSB, 1996c), "CVR (cockpit voice recorder) evidence reveals that the crew may have expected the standard STAR naming convention to be used with respect to the ROZO 1 Arrival and may have incorrectly believed that ROZO was located at the beginning of the route." The second instance of name confusion involved crew confusion of the identifier R for ROZO, which the automated system interpreted to mean ROMEO.

Incidents 223467 and 224363 both involved confusion of identical names in the FMS leading to course deviations.

223467 DEP LGA DEP CTL ALTERED RTE TO DIRECT COL...FO ENTERED COL INTO FMS NAV SYS AND BEGAN FOLLOWING COURSE INFO. COL IN DATA BASE OF FMS WAS LATER FOUND TO BE COLIMA MEX [i.e., Mexico] VOR AND NOT COL COLTS NECK [New Jersey]. DEP CTL QUESTIONED 260 DEG HDG FOR COLTS NECK....I HAVE NOW FOUND OUT THAT MY COMPANY WILL NOT AND DOES NOT GUARANTEE ANY INFO IN THE FMS DATA BANK TO BE CORRECT. I MUST INSURE VIA THE LAT/LONG FROM A COMPANY MAP THAT THEY ARE CORRECT. [also see 223467 in "1.1.1. Automation turns aircraft off course"]

224363 UPON DEP, LGA DEP CTL ALTERED RTING TO DIRECT COL...FO ENTERED COL IDENTIFIER INTO FMS NAV SYS AND BEGAN FOLLOWING COURSE INFO. COL IN DATA BANK OF FMS WAS LATER VERIFIED 1900 MI FROM COL. DEP CTLR QUESTIONED 260 DEG HDG FOR COLTS NECK....THIS RPT SEEMS TO BE A MATCH OF A PREVIOUS PROBLEM WITH COLTS NECK/COLIMA HAVING THE SAME IDENTIFIER, COL THE RPTR IN THIS INCIDENT STATES THAT THE ANOMALY IS STILL IN THE DATA BASE....THIS RPTR STATES THAT THERE ARE OTHER HOLES IN THE DATA BASE, SPECIFICALLY INCLUDING THE NANCI 4 ARR INTO LGA AND THE DARBS 1 ARR INTO TPA. HE PROMISES TO CONTINUE TO FIGHT TO IMPROVE THE DATA BASE. [also see 224363 in "1.1.1. Automation turns aircraft off course"]

315261 AT THIS POINT I REALIZED THAT I HAD BEEN FLYING DIRECT TO THE OM (FONTA) INSTEAD OF PETIS NDB. ... THE FMS NAV DATA BASE LISTS THE OM (FONTA) AS FF26L INSTEAD OF JUST FONTA. MOST NDB'S ARE COLLOCATED WITH THE OM, REFERRED TO AS LOM'S. HUMAN FACTORS BEING WHAT THEY ARE, I SAW FF26L AND USED THAT WAYPOINT THINKING AT THAT MOMENT THEY WERE COLLOCATED AND I WAS FLYING TO PETIS. ACTUALLY THEY ARE ABOUT 5 NM APART. IF THE FMS HAD SHOWN FONTA AS THE OM WAYPOINT INSTEAD OF FF26L I THINK IT WOULD HAVE BEEN CLR THAT THEY ARE IN FACT 2 DIFFERENT POINTS. THERE DOESN'T SEEM TO BE ANY CONSISTENCY WITH THE FMS APCH DATA BASE. SOME APCHS SHOW THE OM NAME AND OTHERS USE THE FF (FINAL FIX) FORMAT. THEY

SHOULD ALL USE THE CORRECT FIX NAMES. ADDING TO THE CONFUSION THE APCH DATABASE SHOWS PETIS AS SBNB.

301760 I DISCOVERED THAT MRLIN WAS NOW ABOUT 5 MI N OF ITS PREVIOUS LOCATION AND TRITN WAS WHERE MRLIN USED TO BE. OUR PROB ACTUALLY OCCURRED BECAUSE WE FAILED TO RECOGNIZE THAT THE ACTIVE DATA BASE IN OUR FMS WAS NOT THE CURRENT DATA BASE DURING THE FMS PREFLT. PERHAPS WHEN THEY ARE CONSIDERING MOVING THE LOCATION OF A FIX THEY SHOULD CONSIDER CHANGING THE NAME AS WELL.

1.1.5. Automation data entry error or data error (6)

321136 AFTER THE FMS RAN OUT ALL THE LEGS, AND WE WERE NOT WITHIN RANGE OF LAND, I DECLARED AN EMER DUE TO OUR INABILITY TO DETERMINE OUR POS. ... FO SAYS LAST MINUTE CONFUSION WHEN DEPARTING RJNN CONTRIBUTED TO THE CAPT INITIALIZING PRESENT POS INCORRECTLY. INSERTED WRONG LONGITUDE. ... THE LONGITUDE WAS E AND SHOULD HAVE BEEN W. ... FUEL WAS DANGEROUSLY LOW, THE FLC HAD NO NAV TO THE HAWAIIAN ISLANDS AND DECLARED AN EMER. COMMERCIAL RADIO RECOMMENDED A HDG CHANGE AND WHEN FINALLY RECEIVING AN ADF SIGNAL, IT TOOK A 90 DEG TURN TO THE R. THEY HAD BEEN PARALLELING THE CORRECT COURSE, BUT 350 MI OFF.

307543 ACFT WAS ON AUTOPLT USING FMS NAV IN MD-11 ACFT. APCH CTL DIRECTED ACFT ON A HDG TO INTERCEPT THE RWY 5L LOC AT RCPT. ... APCH ALERTED CREW TO BEING SE OF COURSE. ... LOC NEEDLE SHOWED CTRED BUT LOC FREQ HAD AUTO-TUNED TO ICKS, THE LOC FREQ FOR ILS-DME RWY 6, WITHOUT THE PLT'S KNOWLEDGE NOR THROUGH EITHER PLT'S ACTIONS. RECEIVED VECTOR TO INTERCEPT RWY 5L LOC ... HE DOES NOT KNOW IF THE CAPT RETUNED THE ILS MANUALLY, AND PUT IN THE WRONG ILS, OR WHETHER THE FMS JUMPED TO THE WRONG ILS BY ITSELF. ... THE RPTING FO KNOWS THAT HE DID NOT AURALLY CHK THE ILS IDENTIFIER AND HE BELIEVES THAT THE CAPT PROBABLY DID NOT EITHER.

342838 DEP CTL SHOWED US OFF COURSE FROM THE SEA 158 DEG RADIAL. I STATED THAT WE WERE CLRED VIA THE FMS DEP AND WERE FOLLOWING THE COURSE IN FMS LNAV AND VNAV. CTLR THEN CANCELED OUR FMS DEP AND ISSUED RADAR VECTORS TO INTERCEPT THE AIRWAY. CTLR THEN STATED, 'DON'T USE THAT FMS DEP, IF WE WERE ON N DEPS YOU COULD GET KILLED DOING THAT.'... THE RPTR STATED THAT PRIOR TO DEP HE DID NOT NOTICE IF THE IRS WAS ALIGNED.

358123 THE HDG BUG IMMEDIATELY SLEWED TO A COURSE OTHER THAN THE INBOUND COURSE AND THE COMMAND BARS WERE COMMANDING TURN TO THE HDG BUG. THE CAPT CLICKED OFF THE AUTOFLT SYS AND FLEW AN UNEVENTFUL MANUAL RAW-DATA APCH. ... WHILE BRIEFING, THE CAPT'S BRIEF WAS INTERRUPTED SEVERAL TIMES WITH ATC ALT CHANGES, TFC CALLS AND A FREQ CHANGE. THE INTERRUPTIONS PROBABLY CAUSED US TO NOT PROPERLY VERIFY THE COURSE IN THE ILS CTL PANEL.

302770 THIS WAS A CASE OF THE FMS PROVIDING FAULTY DSCNT DATA TO THE FLC AND THE FLC FAILING TO BACK UP THE DATA. RELYING ON THE FMS TO SHOW THE DSCNT CAUSED US TO BE TOO HIGH TO CROSS A PUBLISHED RESTR.

156414 WE WERE NAVIGATING USING THE FMS... ATC CALLED...BECAUSE HE SHOWED US ABOUT 8 NM N OF COURSE. ...EVIDENTLY FMS SYS WAS WORKING WITH ERRONEOUS XWIND OF 350/101. WHEN WE SELECTED "PROGRESS PAGE" OF FMS IT SHOWED NO NAVAIDS IN USE, THE SYS WAS "LOST". WE RESET OUR PRESENT POS (USING NAVAID AND DME) ON FMS POS PAGE. ...IT CAUGHT US OFF OUR GUARD.

1.1.6. Other problems getting automation to work as desired (4)

341815 I INFORMED THE CREW TO RPT A DUAL IRS NAV FAILURE AS THEY DID NOT AGREE WITH THE CTLR... AT OUR DEST, THE FO DISCOVERED THE PROB. THE VERY DANGEROUS ERROR AND HIDDEN HONEYWELL 'TRAP.' WE ENTERED AGNEZ MANUALLY AS IT WAS NOT DEFINED IN THE DATABASE. IN SO DOING, THE FO GAVE ME THE WRONG DISTANCE FOR PLACE-BEARING-DISTANCE... I WAS UNABLE TO CORRECT THE ERROR TO MY AMAZEMENT GETTING ERRORS 'FIX USED BY ACTIVE FLT PATH.[’] NOT TO WORRY, I DELETED THE FIX FROM THE ACTIVE FLT PATH AND REENTERED IT, ONLY I FOUND I WAS UNABLE TO NOW DELETE AND CORRECT IT FOR REASONS UNDETERMINED... THE FLT WAS COMPLETED... [On a subsequent flight,] THE INCORRECT FIX WITH CORRECT PLACE-BEARING AND WRONG DISTANCE WAS STILL IN THE DATABASE. ... THE HONEYWELL TRAP!!! THERE IS NO WAY HONEYWELL MAKES THE PLT AWARE THAT THE FIX HE CHOSE WAS MANMADE AND NOT FROM THE DATABASE!

117306 WE GLANCED AT OUR CHARTS, LOCATED POPPS ON THEM, AND THE CAPT TRIED TO ENTER IT AS A WAYPOINT IN THE FMS. THE FMS REJECTED IT AS "NOT IN DATA BASE". ... AT THAT POINT, THE CTLR ASKED IF WE KNEW WE WERE "5 MILES" PAST POPPS. ... OUR FMS DATA BASE SHOULD INCLUDE MOST, IF NOT ALL, POTENTIAL HOLDING FIXES NEAR ARPTS.

116871 CAPT ATTEMPTED TO PROGRAM THE FMS TO COMPLY WITH RESTRICTION BUT DUE TO HIS INEXPERIENCE WITH THE ACFT FMS (2 MONTHS TOTAL ON ACFT) AND THE FACT THAT THE ACFT WAS ON A VECTOR THAT HAD TAKEN IT OFF THE FMS LNAV COURSE [,] THE CAPT COULD NOT PROPERLY PROGRAM THE FMS TO CAUSE THE ACFT TO LEAVE ALT.

249654 THE LGT FMS HAS A NAV PROB ENRTE THAT HAS BEEN RPTED THROUGH MY COMPANY BUT NOTHING HAS BEEN DONE ABOUT IT. WITH THE FMS PROPERLY PROGRAMMED IT DOES NOT ALWAYS MAKE TURNS ENRTE WHICH COMPLY WITH THE REQUIRED ACCURACY AND TECHNIQUE TO SATISFY ATC, EVEN THOUGH THIS FMC AND ACFT ARE FAA CERTIFIED. IT HAPPENS AT MANY DIFFERENT PLACES BUT THE LAS DIRECT GFS DIRECT HEC RTE SEEMS TO BE ONE OF THE WORST.

1.1.7. Miscellaneous over-reliance on automation (5)

303310 A DIFFERENT APCH AND LNDG RWY WAS ASSIGNED. WHILE BRIEFING THE NEW APCH WE BECAME DISTRACTED... WE ASSUMED THE FMS WOULD START THE DSCNT FOR US WHILE BRIEFING THE APCH. LOST SITUATIONAL AWARENESS MOMENTARILY AND SUBSEQUENTLY FAILED TO MEET OUR RESTR.

198046 THE FO FLEW ACCORDING TO WHAT THE INSTS WERE TELLING HIM TO DO THINKING THE COMPUTER MUST KNOW MORE ABOUT THE WIND THAN WE DO. ... I THINK THE BIGGEST PROBLEM WAS MY RELIANCE ON THE FLT DIRECTOR V BARS WHICH CAUSED ME TO DEVIATE SO FAR FROM THE DESIRED COURSE.

251901 UNEXPLAINED AND UNEXPECTED FMS FAILURE. ... ONE CREW MEMBER NOT MANUALLY TUNING OF ABB VOR AS A BACKUP. ... TOO MUCH TRUST IN THE AUTOMATION.

330250 AS THE FMS WAS BEING PROGRAMMED FOR THE INTERCEPT BOTH PLTS NOTICED THE ACFT DSNDING THROUGH 10700 FT. A CLB WAS INITIATED AT 10600 FT AND THE ACFT ONCE AGAIN LEVELED OFF AT 11000 FT. HUMAN PERFORMANCE CONSIDERATIONS -- THE CREW WAS RECEIVING NUMEROUS UPDATED CLRNCS FOR THE DSCNT, THEN A TURN AT LEVEL OFF WHICH REQUIRED ADDITIONAL PROGRAMMING OF THE FMS.

153355 THE FMS DISPLAY WAS SELECTED AND SHOWED US TO BE ON COURSE. ... APCH CTL TOLD US THAT HIS RADAR SHOWED US TO BE +/- 3 MI N OF COURSE. APCH CTL GAVE US A L TURN VECTOR TO RETURN TO COURSE. ... APCH CTL THEN GAVE US A R TURN VECTOR AND WE BELIEVED THAT WE WERE THEN NOT ON THE PUBLISHED ARR. IN FACT THE F/O REMARKED THAT WE MUST BE IN AN APCH CTL VECTOR FOR A W DOWNWIND FOR A S LNDG AT SEATAC. THEREFORE, WE DID NOT MAKE THE PUBLISHED TURN TO 340 DEG.

1.2. Other automation-related problems (1)

(Also see automation-related problems in "2. Confusion, changes, and other problems during descent/approach".)

Incident 238398 involved misuse of automation and problems with crew coordination.

238398 CAPT INSISTED FMS NOT BE PROGRAMMED FOR ANTICIPATED CLRNCS AND NAVAIDS NOT BE TUNED IN ADVANCE. 'THIS IS TO PREVENT THE FMS FROM FLYING A RTE NOT YET CLRED FOR.' HE SAID THE CIVET 3 PROFILE DSCNT WAS NOT IN THE DATABASE. (I CHKED AHEAD OF TIME -- IT WAS.) ... I SET THE FIRST 'AT OR ABOVE' OF 14000 FT IN THE ALT WINDOW OF THE FLT CTL PANEL. THE CAPT RESET 10000 FT AND SAID SOMETHING TO ME ABOUT, 'TRUSTING THE FMS TO FLY THE PROFILE ACCURATELY.'...I LOOKED UP TO SEE THE ACFT PASSING THROUGH 12000 FT PRIOR TO THE 'AT OR ABOVE' RESTRICTION... APCH CANCELLED OUR APCH CLRNC AND ASKED US OUR SPD. ... SHORT OF 'OVERRIDING' THE CAPT AND TAKING PHYSICAL CTL OF THE ACFT, I'M NOT SURE I COULD HAVE DONE ANYTHING DIFFERENTLY... .

2. Confusion, changes, and other problems during descent/approach (29)

2.1. Last minute approach/runway change leads to significant confusion (3)

The Cali accident involved additional workload imposed on the crew by their acceptance of a runway change during the automation-aided approach. This change created time pressure on the execution of procedures and led to significant crew confusion.

Incident 310130 is one of the two incidents rated by all three analysts as highly relevant to the Cali accident. The other is 368360 in section 1.1.3. See appendix 3, table 1 for the list of incidents sorted on their relevance ratings. Incident 310130 involved not only a last minute approach/runway change, but also confusion during descent/approach, problems with crew decision making, confusion regarding charts, and problems with crew coordination.

310130 AT THE LAST MIN, AFTER WE WERE VECTORED DIRECT TOWARD THE OUTER LOCATOR 'OC', WE WERE CLRED FOR A 'STRAIGHT IN LNDG ON RWY 11' AND TOLD TO RPT OVER 'OC.' ... THE FO INITIALLY SET UP HIS RADIO ON THE LOC 110.1, BUT THERE WAS NO LOC OR ANYTHING ON THAT FREQ. ... WE HAD BRIEFED BOTH THE ILS TO RWY 35 WITH A CIRCLE TO LAND AND THE LOC-VOR-DME RWY 11 APCH, BUT NOT A STRAIGHT IN APCH. THE ONLY STRAIGHT IN APCH WAS AN ADF LOCATOR APCH, WITH DME. ... MEANWHILE I WAS TRYING TO FIND AN APPROPRIATE APCH PAGE. WE SETTLED ON 11-2 CHART SINCE THE CTLR HAD CALLED THE APCH A 'STRAIGHT-IN APCH.' ... I SAID 'I AM CONFUSED.' I DIDN'T UNDERSTAND WHY WE WERE DSNDING AND THE FO HAD ALL FLAGS WITH HIS RADIO ON THE ILS FREQ. ... I COULDN'T FIGURE OUT WHICH APCH HE WAS USING, AND I HAD TROUBLE READING HIS CHART FROM ACROSS THE COCKPIT. THEN THE SO MENTIONED THAT WE HAD A 3000 FT MSA. WE WERE AT 2650 FT... THE APCH WE WERE FINALLY GIVEN, OR FLEW ANYWAY, DID NOT CONFORM TO ANY OF THE PLATES. ... I ACCEPTED THE CLRNC FOR A STRAIGHT-IN APCH, NOT KNOWING WHICH APCH.

Incident 146645 involved not only the effect of changes late in descent/approach, but also confusion regarding charts, erroneous data entry, and automation turning the aircraft off course.

146645 I TUNED AND SET THE NAV EQUIP FOR THE ILS TO RWY 32 AND ANNOUNCED THAT THE APCH CHK WAS COMPLETE.... HOWEVER, OUR POS AND HDG RELATIVE TO THE LOC WAS LOOKING LIKE AN EXTREMELY TIGHT TURN ON OR AN OVERSHOOT, SO I REQUESTED OUR CURRENT HDG AND ALT ASSIGNMENT FROM APCH. WHAT WE RECEIVED WAS A TURN AND CLRNC FOR THE NDB APCH RWY 30 CIRCLE TO LAND RWY 32 AT STP AND TO CONTACT ST PAUL TWR. WHILE HURRYING TO GET THE NAV EQUIP RETUNED AND IDENTED AND RECONFIGURING THE ACFT I WENT RIGHT BY THE NDB RWY 30 CHART AND TOOK THE DATA FROM THE NDB RWY 3 ST PAUL, MN, LAKE ELMO. AS WE WENT BY THE NDB AND STARTED TO TURN TO THE INBND HDG, SOME 70 DEG FROM OUR CURRENT HDG, WE KNEW SOMETHING WAS WRONG. A QUICK CHK OF THE CHART CONFIRMED THE ERROR I HAD MADE. ... THE TWR CALLED AND SAID APCH SHOWED US NE OF COURSE. ... WE, AS A FLT CREW, SHOULD NOT HAVE ACCEPTED THE CLRNC FOR AN APCH TO A RWY DIFFERENT FROM THE ONE WE WERE SET UP FOR, UNLESS WE WERE SURE WE HAD TIME TO SET UP AND CONFIGURE FOR THE APCH TO THE NEW RWY. [also see 146645 in "1.1.1. Automation turns aircraft off course" and "2.2.2. Confusion regarding charts"]

Incident 306151 involved not only the effect of changes late in descent/approach, but also confusion, crew coordination problems, and loss of situational awareness.

306151 APCH CTL ASSIGNED US THE ILS FOR RWY 7. ... THEN APCH CTL ASSIGNED US THE ILS FOR RWY 8. ... JUST OUTSIDE THE OM WE SWITCHED TO TWR. TWR ASKED IF WE COULD ACCEPT LNDG ON RWY 17R. THE CAPT ACCEPTED. I IMMEDIATELY ASKED WHERE RWY 17R WAS. THERE WAS NO RESPONSE TO MY QUESTION. ... ON THE MISSED APCH I HAD TO CALL 3 TIMES FOR THE CAPT TO SET MAX PWR AND FLAPS TKOF. ... HE SAID HE WAS STILL THINKING ABOUT WHAT HAPPENED BACK THERE. I SAID, 'YOU NEED TO BE THINKING ABOUT THIS APCH NOW. FLY THIS APCH NOW.' ... THE FACT IS, NEITHER OF US KNEW WHERE RWY 17R WAS IN RELATION TO RWY 8. ... THE CAPT ACCEPTED A CLRNC WHEN HE SHOULD NOT HAVE. ... I DID NOT TAKE THE INITIATIVE TO STOP A SIT I WAS UNCOMFORTABLE WITH.

2.2. Other confusion during descent/approach (11)

2.2.1. Name confusion (5)

(Also see section "1.1.4. Name confusion using automation" in section "1.1. Over-reliance on automation.")

The Cali accident involved two distinct instances of name confusion. First, the arrival was named ROZO 1, instead of TULUA 1, which appeared to confuse the captain. According to the NTSB report (NTSB, 1996), "CVR (cockpit voice recorder) evidence reveals that the crew may have expected the standard STAR naming convention to be used with respect to the ROZO 1 Arrival and

may have incorrectly believed that ROZO was located at the beginning of the route." The second instance of name confusion involved crew confusion of the identifier R for ROZO, which the automated system interpreted to mean ROMEO.

Among the following incidents involving name confusion, several also involved miscommunication between the crew and controller.

In addition to name confusion, incidents 310228 and 274820 involved problems with situational awareness.

310228 UNBEKNOWNST TO US THERE ARE 2 APCHS, ONE NAMED THE (GPS) VOR/DME RWY 33L AND THE OTHER NAMED VOR DME OR GPS A. WE UNDERSTOOD THE CLRNC TO BE FOR THE (GPS) VOR DME RWY 33L WHICH HAS AN INBOUND COURSE OF 342 DEGS, WHILE THE APCH CTLR UNDERSTOOD THE CLRNC TO BE FOR THE VOR DME OR GPS A APCH WHICH HAS AN INBOUND COURSE OF 310 DEGS. SINCE WE WERE LOOKING TO INTERCEPT THE 342 DEG COURSE WE OVERSHOT THE 310 DEG COURSE. TWR TOLD US WE WERE L OF COURSE. ... ONE FURTHER POINT OF CONFUSION: THE FINAL APCH FIX FOR THE VOR DME OR GPS-A APCH IS BEEJE AND THE FAF FOR THE (GPS) VOR DME RWY 33L IS MEACH. THESE SOUND VERY SIMILAR AND COMBINED WITH THE ALMOST IDENTICAL APCH NAMES CREATES A STRONG POTENTIAL FOR CONFUSION.

274820 I ANTICIPATED VFR CONDITIONS...I WAS NOT AS MENTALLY PREPARED FOR THE UPCOMING INST APCH AS I WOULD HAVE BEEN OTHERWISE. WE DECIDED THE VOR DME C APCH WOULD BE BEST... HOWEVER, AFTER INTERCEPTING THE FINAL APCH COURSE MCGRATH RADIO BEGAN TO QUESTION OUR LOCATION AND WE SOON LEARNED THAT WE HAD BEEN CLRED FOR THE VOR DME 16 APCH INSTEAD OF THE VOR DME C APCH.

142553 THE WORD "VIS" IS INAPPROPRIATE IN THE NAME OF IFR/VFR APCH. BOTH PLTS HEARD "VIS APCH" NOT "QUIET BRIDGE VIS APCH!". PLTS ARE TRAINED TO KEY ON THE PHRASE "CLRED FOR VIS APCH" AND CAN BE MISLED IF SUCH WORDING IS CONTAINED IN AN APCH WHICH IS NOT A PURE VIS.

310989 I HAD ARRIVED AT ARCHI WITHOUT ANY ADDITIONAL RTE CLRNC. IT IS NOT CLR THAT THE ORIGINAL CLRNC TO INTERCEPT THE SFO 095 DEG STILL APPLIES AFTER BEING AMENDED TO FLY DIRECT ARCHI. ... I QUERIED 134.5 ABOUT OUR CLRNC AFTER ARCHI. BAY APCH RESPONDED, 'INTERCEPT THE FINAL APCH COURSE.' THIS WAS THE FIRST TIME I HAD HEARD THE TERM 'FINAL APCH COURSE' REFERRING TO THE SFO 095 DEG RADIAL. I INQUIRED AGAIN FOR CLARIFICATION, 'THAT IS NOT CLR TO ME, SHOULD WE INTERCEPT THE SAN FRANCISCO 095 DEG RADIAL?' ... THE CTLR INSISTED ON USING ONLY THE TERMINOLOGY 'FINAL APCH COURSE' AND WOULD NOT RESPOND OTHERWISE TO MY REPEATED ATTEMPTS TO RECONCILE MY UNCERTAINTY...

335430 WE THOUGHT AT THIS TIME THAT THE VOR 17 APCH WAS IN USE. MANCHESTER HAS 2 VOR APCHS TO RWY 17 (VOR 17, CHART 13-2) WHICH UTILIZES THE MHT VOR AND THE VOR DME 17 WHICH USES THE CONCORD VOR (APCH CHART 13-3). ... AS WE INTERCEPTED THE FINAL APCH HE ADVISED US THAT WE WERE 1/4 MI R OF COURSE AND THAT THE APCH USED THE CONCORD VOR.

2.2.2. Confusion regarding charts (4)

Incident 352618 not only involved confusion regarding charts, but also involved confusion regarding the detailed representation of terrain on charts. It also involved complacency in the presence of terrain. See the excerpt in section 3.1.1.

352618 WE FELT THAT THERE WAS SOME AMBIGUITY ABOUT TERRAIN CONTOURS DEPICTED ON THAT CHART AS COMPARED TO THE AREA CHART FOR LAS VEGAS. THE APCH CHART SHOWS A CONTOUR INTERVAL MARKED 3000 FT, AND THE SAME INTERVAL IS MARKED 4000 FT ON THE AREA CHART. ...I SAW THE NUMBER 3000 FT AND FORGOT THAT IT WAS A CONTOUR INTERVAL EXTENDING FROM 3000 FT TO 4000 FT IN THE AREA WE WERE IN. [also see 352618 in "3.1.1. Complacency, loss of situational awareness, slow reaction"]
Narrative 226114 is one of those rare ASRS reports that describes a situation that seems unsafe to the reporter, as opposed to a particular incident. This situation, in Juneau, Alaska, is of such importance that special procedures are being developed for it (Steenblik, 1998).

226114 THIS IS THE 3RD MAJOR ACCIDENT ON THE APCH FOR JNU (LDA 1 RWY 8). ALL 3 ACFT (ACR-LGT, ACR-LTT, MIL-MLT) HIT WITHIN 1/2 MI OF EACH SEPARATE ACCIDENT SITE. ALL 3 CREWS APPARENTLY MISIDENTED BARLO, THE FINAL APCH FIX. I KNOW FROM MY PERSONAL EXPERIENCE, THAT THE APCH PLATE TAKES A LOT OF STUDYING BECAUSE OF ALL THE POSSIBLE TRANSITIONS. ... I THINK HAVING LESS CLUTTER ON THE PLATE WOULD BE A BIG HELP. ...CHART IS CONFUSING.

In addition to confusion regarding charts, incident 146645 also involved automation turning the aircraft off course (see further excerpt in section 1.1.1.) and a last minute approach/runway change leading to significant confusion (see further excerpt in section 2.1.).

146645 WHILE HURRYING TO GET THE NAV EQUIP RETUNED AND IDENTED AND RECONFIGURING THE ACFT I WENT RIGHT BY THE NDB RWY 30 CHART AND TOOK THE DATA FROM THE NDB RWY 3 ST PAUL, MN, LAKE ELMO. AS WE WENT BY THE NDB AND STARTED TO TURN TO THE INBND HDG, SOME 70 DEG FROM OUR CURRENT HDG, WE KNEW SOMETHING WAS WRONG. [also see 146645 in "1.1.1. Automation turns aircraft off course" and "2.1. Last minute approach/runway change leads to significant confusion"]

365456 THE EASTSIDE ONE ARR IS THE ONLY FMS ARR KNOWN TO THIS AVIATOR TO RETAIN DSCNT CLRNC AFTER BEING CLRED FOR FMS APCH. CERTAINLY, A SIT FOR CONFUSION WHEN COMPARED TO MOST, IF NOT ALL OTHER FMS APCHS I'M FAMILIAR WITH. ... UPON REVIEWING THE FMS STAR CHART, HE SAW THE NOTE ABOUT MAINTAINING THE LAST ASSIGNED ALT UNTIL PASSING KAYOH, HOWEVER, HE STILL THINKS THAT THE STAR IS MISLEADING AND ITS FORMAT CONFUSING.

2.2.3. Confusion due to use of wrong data (2)

335098 I WAS SURPRISED TO FIND MY DME INDICATING 13.5, OR 1.5 MI PAST FERNS. I IMMEDIATELY INITIATED DSCNT TOWARD 1200 FT, OUR NEXT STEP-DOWN ALT. SHORTLY, THE FO INDICATED SOMETHING WAS NOT RIGHT. ... I THEN DISCOVERED MY DME HOLD FEATURE WAS ENGAGED AND IMMEDIATELY SELECTED IT OFF. MY DME THEN READ APPROX 10.5 AND I REALIZED WE HAD NOT YET REACHED FERNS. ... WE HAD DSNDED SEVERAL HUNDRED FT BELOW THE MINIMUM ALT OF 2000 FT.

Incident 212324 involved data entry error and use of the wrong navigational beacon.

212324 I HAD ABE IN VOR AND WE WERE SUBSEQUENTLY CLRED THE LOC BACK COURSE APCH TO RWY 24. I FAILED TO TUNE IN ETX VOR FOR DME INFO. CAPT WAS FLYING AND NOTICED DME WAS ABOUT 10 DME. HE BEGAN DSCNT DOWN TO THE MDA OF 760 FT MSL. AT ABOUT 1000 FT MSL (600 FT AGL) TWR CALLED AND SAID WE WERE WELL BELOW THE PROPER ALT FOR THE APCH AND WE SHOULD CLB BACK IMMEDIATELY.

2.3. Forgot speed brakes (2)

The Cali accident involved execution of a terrain escape maneuver without retraction of the speed brakes. Two of the incidents relevant to the Cali accident involved forgetting to retract the speed brakes.

334866 I AM NEW ON THE B757...WE HAD TO USE SPD BRAKES BTWN ARCHI AND GAROW INTXNS TO GET DOWN TO PROFILE. ...AIRPLANE DIDN'T STOP AT THE PROFILE, IT KEPT DSNDING AND BUSTED THE 4000 FT RESTR AT GAROW INTXN BY 400 FT. IT TOOK ME A FEW SECONDS TO REALIZE WHY -- AS THE ACFT APCHED THE PROFILE, I HAD NOT RETRACTED THE SPD BRAKES SINCE I WAS DISTRACTED AND THERE ARE NO INDICATIONS OF SPD BRAKE DEPLOYMENT TO REMIND YOU.

Incident 280233 not only involved forgetting the speed brakes, but also involved a GPWS warning.

280233 I CALLED FOR 'GEAR-DOWN' AND EXTENDED SPD BRAKES TO AID DSCNT. ... AT 8200 FT... I RAISED THE NOSE TO ARREST SINK RATE AND DECELERATE AT 7200 FT. ... I APPLIED THRUST AND NOTICED I WAS USING CONSIDERABLY MORE THAN NORMAL TO MAINTAIN LEVEL FLT. ... AT APPROX 200 KTS, I GOT THE STALL SHAKER... I INSTINCTIVELY LOWERED THE NOSE AND ADDED THRUST. AT 6500 FT THE GPWS ISSUED A 'TERRAIN' WARNING. THE FE THEN ALARMED ME THE SPD BRAKES WERE STILL EXTENDED.

2.4. Other problems with changes late in descent/approach (4)

Incident 275413 involved not only the effect of changes late in descent/approach, but also loss of data when other data are entered into the automated system.

275413 AT THIS POINT, TO COMPLY WITH THE 210 KIAS SPD REQUEST BY ATC, THE FO SELECTED THE 'VERT SPD' FUNCTION ON THE DIGITAL FLT GUIDANCE PANEL, SETTING 600 FPM DSCNT RATE AND CHANGING THE 'SPD SELECT' WINDOW TO SHOW 210 KTS. BECAUSE OF A FLAW IN THE MD-88'S DIGITAL FLT GUIDANCE PROGRAM, LAST SECOND CHANGES IN ANY OF THE VERT CTL FUNCTIONS WILL REMOVE THE ALT LEVEL OFF COMMAND PREVIOUSLY SELECTED. THE ALT WARNING SIGNAL AND A TCASII 'TA' GOING OFF SIMULTANEOUSLY AT 7700 MSL BROUGHT OUR ATTN TO THE DEV. [also see 275413 in "1.1.2. Loss of data when other data are entered"]

310373 WE WERE BEING VECTORED FOR THE 'CANARSIE APCH' (VOR RWY 13L/R) AT JFK. ... THE CRI VOR WAS AT 12 O'CLOCK (STRAIGHT AHEAD), ABOUT 5 MI. THE PNF INDICATED TO ME SHORTLY THEREAFTER THAT THE USUAL VISUAL REF POINTS JUST BELOW US WERE NOT WHAT THEY SHOULD BE. I CHKED MY RMI NEEDLES (WE BOTH HAD THE CRI VOR TUNED AND IDENTED) AND SAW THEM SWINGING OFF TO THE R, ABOUT 2.5 DME. I RECHKED MY 'NAV' (FMS) DISPLAY, AND IT WAS NO LONGER AT 12 O'CLOCK, BUT NOW WAS OFF TO THE R (SEE NOTE). IT HAD BEEN AT 12 O'CLOCK, 5 MI, ONLY 4-5 SECONDS PRIOR TO THAT. WE INITIATED A R TURN AND I IMMEDIATELY SWITCHED TO 'RAW DATA' TO COMPLETE THE APCH. ... WHEN VECTORS ARE CHANGED CLOSE TO THE FAF, MORE THAN THE NORMAL XCHK MUST BE ACCOMPLISHED BY THE PLT WHO HAS TO QUICKLY GO FROM FMS INFO TO RAW DATA INFO, DECIPHER, SWITCH DISPLAYS, FLAG THE APCH, CONFIGURE, DSND TO MDA, ETC.

217430 RWY 36R ILS WAS BRIEFED. AT GILMORE, WE WERE CLRED DIRECT TO AULON FOR THE ILS RWY 9. I TOLD THE FO TO BRIEF ME ON THE APCH WHILE I ACTIVATED THE SECONDARY FLT PLAN IN THE FMS. WE WERE CLRED TO DSND TO 3000 AND I BEGAN A RAPID DSCNT TO THAT ALT AS THE ARPT WAS NOW VERY CLOSE. ... I GLANCED QUICKLY AT THE APCH PLATE FOR ILS RWY 9 AND SAW 1500 AS THE INTERMEDIATE APCH ALT. ... WE WERE ASKED OUR ALT BY APCH AND WE RPTED 1500 FT. THEY ADVISED THEY WERE RECEIVING A LOW ALT ALERT.

335282 WHILE TURNING ONTO THE FINAL APCH PATH, WHILE IN CONTINUOUS MODERATE TURB AND MODERATE RAIN SHOWERS, THE APCH CTLR INFORMED US THAT A PRECEDING FLT MISSED THE APCH AND INFORMED US THAT WE MIGHT HAVE BETTER LUCK WITH THE ROSSLYN LDA RWY 18. THE CTLR THEN CLRED US FOR THE ROSSLYN LDA RWY 18 APCH. SINCE THIS WAS THE FIRST WE HEARD THAT THE ROSSLYN LDA WAS IN USE, WE WERE VERY RUSHED PREPARING FOR THE APCH. ... [Part of the problem is] THE LACK OF STORED APCH INFO FOR THE APCHS TO RWY 18. ... THE FLC EITHER HAS TO FLY THE APCH USING THE APCH PLATE ONLY OR TAKE THE TIME (WHICH WAS NOT AVAILABLE) AND ENTER EACH WAYPOINT INTO THE FMC. THE APCH PLATE ITSELF MUST BE BRIEFED AND THESE LAST MIN CHANGES CREATE A VERY HIGH WORKLOAD, HIGH STRESS, ENVIRONMENT IN THE COCKPIT.

2.5. Miscellaneous problems during descent/approach (9)

282707 HAD DSCNT CONTINUED THERE WOULD HAVE BEEN A COLLISION. ... ONE BECOMES CONFIDENT AND TRUSTING WHEN BEING CTLED INTO AN ARPT OF THE SIZE OF SFO. WE RELY ON TFC SEPARATION. IT IS ALSO A TIME THAT IS VERY BUSY FOR FLC -- SETTING UP FMS, FINAL APCH BRIEFINGS, CHKLISTS, MONITORING APCH FREQS TO HEAR WHAT OTHER ACFT ARE DOING. THANKS TO A DILIGENT AND OBSERVANT FO AND TCASII, THIS POTENTIAL COLLISION WAS AVOIDED.

279493 FLYING UP HUDSON RIVER ... WE WERE THEN CLRED TO FLY THIS APCH. OUR APCH PLATE SPECIFIES 'REMAIN ABOVE 2000 FT AS LONG AS POSSIBLE' BUT NO OTHER ALT RESTRS. ... CTR TOLD US WE WERE NOT CLRED FOR LOWER AND TO CLB BACK TO 3500 FT. ... QUALITY ASSURANCE SPECIALIST STATED THE RPTR IS CORRECT. HE CAN DSND TO 2000 FT.

309352 THE APCH PLATE SPECIFIES FOR US TO REMAIN 'AT OR ABOVE 2000 FT AS LONG AS POSSIBLE.' ... APPROX ABEAM THE WORLD TRADE CTR, THE APCH CTLR ... ASKED WHAT OUR ALT WAS AND I REPLIED WE WERE PASSING 2500 FT GOING DOWN TO 2000 FT. HE RESPONDED THAT WE WERE SUPPOSED TO MAINTAIN 3000 FT MSL UNTIL ABEAM CENTRAL PARK.

363380 ACFT WAS AT 2800 FT DSNDING. ... REMEMBERED ALT ASSIGNED AND A CLB STARTED BACK TO 3000 FT. ... IN FUTURE, RECOMMEND THE PF USE AUTOPLT TILL ESTABLISHED ON FINAL APCH COURSE IN ORDER TO FREE UP MENTAL WORKLOAD TO BETTER IMPROVE SITUATIONAL AWARENESS.

99108 WE WERE ADVISED BY COAST APCH THAT THE RWY LIGHTS ON ALL RWYS WERE NOT TURNING ON. ... HE THEN ASKED APCH WHAT TIME SUNSET WAS, AND THEY INFORMED HIM 3 MINS AGO. ... WE COULD STILL SEE THE ARPT, AND IT WAS STILL LIGHT OUT, SO THE CAPT TOLD APCH WE WOULD CONTINUE.

242545 I WAS TOLD THAT OUR CLRNC WAS TO THE HUSON FIX, VIA THE 13 DME ARC, MAINTAIN 13000 FT, EXPECT NO DELAYS FOR THE VOR DME-A APCH. THIS IS THE CLRNC THAT MY FO RECEIVED WHILE I WAS OFF THE AIR. HE STATES THAT HE MISTOOK THIS FOR AN APCH CLRNC.

84811 I EXPLAINED ABOUT BEING ON A VISUAL APCH AND HE SAID I SHOULD HAVE RECEIVED THE XING RESTRICTION. I CONFERRED WITH MY FIRST OFFICER AND WE BOTH AGREED THAT WE HAD NOT RECEIVED THE RESTRICTION.

115883 MOUNT VERNON VISUAL APCH TO RWY 36 WASHINGTON NAT'L. WASHINGTON APCH FAILED TO CHANGE FLT OVER TO TWR. FLT CREW DID NOT REALIZE THAT RADIO WAS TUNED TO APCH AND FAILED TO REQUEST LNDG CLRNC FROM TWR.

307161 WHILE BEING VECTORED FOR AN NDB APCH AND WHILE ON DOWNWIND, THE CREW WAS TOLD BY ATC, 'UNITED STATES CUSTOMS REQUIRES NXXXXX TO BE DIVERTED TO FT PIERCE SO AS TO CLR CUSTOMS AND THAT LNDG CLRNC TO MELBOURNE IS DENIED.' ATC WAS ADVISED BY THE CREW THAT THE AIRPLANE HAD NOT LANDED IN A FOREIGN COUNTRY AND THAT 4 FAA INSPECTORS WERE ONBOARD THE ACFT.

3. Terrain avoidance (19)

3.1. GPWS alarms (15)

The many GPWS alarms in the ASRS database illustrate the kinds of experiences flight crews have with this terrain avoidance system. Previous experience with false GPWS alarms can be a factor in accidents involving controlled flight into terrain (Majikas, 1995).

3.1.1. Complacency, loss of situational awareness, slow reaction (5)

351150 APPROX 30 MI S OF LAS, RECEIVED CLRNC FOR VISUAL APCH RWY 1R, VASI OTS. DISCUSSED WITH FO IMPLICATIONS OF DSNDING VISUALLY IN MOUNTAINOUS TERRAIN OFF PUBLISHED RTE, PLUS NO GS INFO. WE WERE LULLED INTO A FALSE SENSE OF SECURITY BY FAMILIARITY OF AREA, GOOD VISIBILITY, AND TERRAIN BEING WELL LIT BY FULL MOON. APPROX 10 MI S OF LAS ON THE 180 DEG RADIAL, CTLR ISSUED A 'BELOW MVA' ALERT. WE WERE AT 4100 FT MSL. SECONDS LATER, A GPWS WARNING 'TERRAIN, TERRAIN' ONLY SOUNDED WITH TERRAIN IN SIGHT. AN IMMEDIATE CLB WAS INITIATED...

Incident 352618 also involved confusion regarding charts. See the excerpt in section 2.2.2.

352618 THE CAPT STATED THAT WE WERE GOOD TO DSND NOW TO 4100 FT. I COMMENTED THAT THE AIRSPACE THAT PROTECTED US AT 4100 FT WAS ONLY VALID ONCE WE WERE ESTABLISHED ON FINAL AND OVER THE FIX INBOUND. HE SAID HE WAS SURE IT WAS SAFE... THE CAPT SEEMED VERY CONFIDENT AND NOTHING IN HIS MANNER SIGNALED THAT I SHOULD BE AT ALL CONCERNED ABOUT HIS JUDGEMENT. I REMEMBERED THINKING EARLIER THAT HE SEEMED LIKE A REALLY GREAT GUY TO FLY WITH: VERY PROFESSIONAL AND SELF-ASSURED, WITH VERY GOOD PEOPLE SKILLS TOO. ... ALMOST IMMEDIATELY THE CAPT SAID SOMETHING ABOUT A MOUNTAIN BEING VISIBLE OUTSIDE THE WINDOW. I LOOKED OUT AND OUR LNDG LIGHTS WERE CLEARLY ILLUMINATING A LARGE PEAK BELOW OUR NOSE. THE CAPT SAID, 'THE RADIO ALT IS SHOWING 1000 FT, LET'S GET OUT OF HERE!' I DISCONNECTED THE AUTOPLT AND INITIATED A CLB AT TOGA THRUST BACK UP TO 6000 FT, SHORTLY AFTER I STARTED THE CLB, THE GPWS CALLED 'TERRAIN, TERRAIN!' [also see 352618 in "2.2.2. Confusion regarding charts"]

363536 CTLR GAVE US A VECTOR... SHORTLY AFTER THIS THE GPWS ALERTED US TO 'TERRAIN, TERRAIN.' AN IMMEDIATE CLB WAS INITIATED AND THE ACFT WAS SUBSEQUENTLY LANDED SAFELY. ... THIS ACR DOES NOT USE ANY TERRAIN AWARENESS IN THEIR APCH BRIEFINGS. ... FO ADMITS TO IT BEING VERY MUCH OF A RUSHED ATMOSPHERE AND ADMITS TO A LOSS OF SITUATIONAL AWARENESS IN EVENT.

Incident 82787 also involved lack of detailed terrain information on approach charts.

82787 I YELLED, "CLB NOW," VERY FORCEFULLY. WHEN THERE WAS NO IMMEDIATE RESPONSE, I HIT AUTOPLT DISCONNECT AND PULLED UP. ... THIS HAS HAPPENED BEFORE IN THIS LOCATION. A FOREIGN CARRIER HAS CONDUCTED EXTENSIVE RESEARCH. THERE IS A 5637' HILL IN THE AREA THAT SHOWS ON THE DEP CHART, BUT IT IS NOT DEPICTED ON THE APCH CHART. THE CHART PUBLISHER HAS BEEN CONTACTED AND THEY SAID THEY WOULD INCLUDE THIS HILL ON FURTHER APCH CHARTS. RPTR WAS PARTICULARLY DISTURBED BY THE FACT THAT HIS SKILLED AND COMPETENT F/O FROZE IN THE MACHINE MODE AND TRIED TO COMPLY WITH THE GPWS INSTRUCTIONS WITH THE AUTOPLT CTLS RATHER THAN EXECUTING AN IMMEDIATE PULLUP MANUALLY.

346137 AFTER LEVELING AT 4600 FT MSL FOR 15-20 SECONDS THE GPWS (MODE 2) 'TERRAIN, TERRAIN' ALERTED, BOTH PLTS WERE SURPRISED AS WE HAD ASSUMED THAT 4600 FT WAS MINIMUM VECTOR FOR THAT AREA. AS GPWS ALERTED SECOND TIME, PLTS INITIATED ESCAPE MANEUVER WITH GAR THRUST FOR MAX CLB ANGLE.

3.1.2. Miscellaneous GPWS alarms (10)

325026 PASSING THROUGH 3000 FT MSL, WE RECEIVED A GPWS ALERT WARNING OF 'TERRAIN, TERRAIN.' I IMMEDIATELY INITIATED THE PRESCRIBED PROC OF FIREWALL PWR AND PITCH TO 20 DEGS NOSE UP. THE WARNING CONTINUED FOR ABOUT 10-15 SECONDS. ... THE ACFT HAD TO HAVE THE ENGS INSPECTED AS THE PF HAD 'FIREWALLED' THE ENGS IN THE CLB MANEUVER, OVERTEMPING THEM IN THE PROCESS. THE ACFT WAS FERRIED BACK TO ATL THE NEXT DAY. ... THE ACFT HAD ITS SPOILER-SPD BRAKES DEPLOYED. THE CREW, IN COGNIZANCE OF THE LATEST ACCIDENT IN S AMERICA, DID NOT FAIL TO REMEMBER THE ACFT'S CONFIGN AND RETRACTED THE SPOILERS... THE AREA SE OF HUNTSVILLE ARPT HAD A HISTORY OF ERRONEOUS GPWS WARNINGS.

174048 AFTER DSNDING TO 3800' MSL THE GPWS ISSUED A CONTINUOUS AURAL AND VIS "TERRAIN" ALERT. SINCE WE COULD NOT IMMEDIATELY DETERMINE VISUALLY THAT WE HAD ADEQUATE TERRAIN CLRNC AND THE RADAR ALTIMETER INDICATED DECREASING GND CLRNC, WE INITIATED A CLB ... ROA HAS BEEN DESIGNATED BY THE FAA AS A SPECIAL ARPT DUE TO MOUNTAINOUS TERRAIN AND HIGH OBSTRUCTIONS IN THE AREA. BECAUSE OF THE SPECIAL NATURE OF THIS ARPT, COMPANY HAS 9 PAGES OF INSTRUCTIONS TO AID FLT CREWS IN ARR, APCH AND DEP PROCS.

201005 WE WERE INSTRUCTED TO CLB TO 8000 FT, AND TURN TO A HDG OF 180. AFTER WE WERE LEVEL AT 8000 FT, AND ON THE 180 HDG FOR SOME TIME, WE RECEIVED A CONTINUOUS TERRAIN WARNING FROM THE GPWS. THIS WAS OVER A COMPLETELY DARK AREA ... I INITIATED A CLB AND THE FO ADVISED APCH CTL ... THE APCH CTLR STATED THAT HE WAS PROVIDING TERRAIN CLRNC FOR US AND FOR US TO MAINTAIN 8000 FT... BUT DID GIVE US A TURN TOWARD THE CTR OF THE VALLEY. WE TURNED, BUT IGNORED THE ALT INSTRUCTION AND CONTINUED THE CLB ENOUGH TO SILENCE THE GPWS WARNING. A CTLR'S EX POST FACTO STATEMENT THAT HE IS PROVIDING OBSTACLE CLRNC IS SMALL COMFORT WHEN 'WHOOP, WHOOP, PULL UP' IS RINGING IN ONE'S EAR.

317197 OVER THE RIDGE OF HILLS WE WERE STARTLED TO HEAR OUR GPWS ANNOUNCE 'TERRAIN, TERRAIN' THIS STARTLED US SINCE AS I MENTIONED EARLIER WE WERE AT AN ATC CLRED ALT AND HDG AND COULD VISUALLY SEE THAT WE WERE IN NO DANGER OF BEING NEAR TERRAIN. OF COURSE THE CAPT REACTED TO THE WARNING IMMEDIATELY...

362229 INBOUND TO LAS...WE RECEIVED A GPWS TERRAIN WARNING. IN COMPLIANCE WITH OUR COMPANY PROCS, I INSTRUCTED THE FO TO INCREASE PWR AND CLB. ...SINCE WE WERE AT THE MVA OF 6100 FT MSL, I FEEL THAT WE WERE GIVEN AN INCORRECT TERRAIN WARNING.

300252 AS THE CTLR GAVE US THE HDG TO INTERCEPT THE LOC COURSE, HE ADVISED THAT THE HDG AND ALT MIGHT CAUSE A GPWS WARNING THAT HE CHARACTERIZED AS SPURIOUS, BUT THAT WE WOULD CLR THE TERRAIN. ... I HAD BRIEFED THAT WE WOULD RESPECT ALL GPWS WARNINGS DURING OUR OPS AT RNO.

329185 DURING APCH PHASE OF ARR INTO RNO WE EXPERIENCED A GPWS WARNING OF 'TERRAIN' FOLLOWED BY 'PULL UP.' ... THE CAPT WAS TOLD BY A SUPVR THAT THIS HAPPENS ALL THE TIME OVER HAZEN MOUNTAIN. THE MOUNTAIN IS ABOUT 7800 FT HIGH WITH A TWR ON IT SO THE GPWS GOES OFF.

354277 WHILE ON ARR INTO SLC, WE WERE CLRED TO DSCNT TO 9000 FT. AS WE DSNDED THROUGH 9500 FT IN IMC OUR GPWS TERRAIN WARNING BEGAN SOUNDING CONTINUOUSLY SO WE INITIATED A CLB AND INFORMED APCH WE WERE CLBING TO 11000 FT. THE CTLR RESPONDED THAT 9000 FT WAS ABOVE MVA AND STARTED TO GIVE US AN 8000 FT XING RESTR FOR OUR INST APCH TO RWY 34L. ... I DON'T THINK THAT THIS PARTICULAR CTLR FULLY APPRECIATES THE EFFECT THAT THE TERRAIN WARNING HAS ON A FLC ESPECIALLY AT NIGHT, UNDER INST METEOROLOGICAL CONDITION, AND IN MOUNTAINOUS TERRAIN.

355364 WE RECEIVED A GPWS WARNING 'TOO LOW, TERRAIN.' FLC IMMEDIATELY PERFORMED ESCAPE MANEUVER. ... WE BELIEVE THAT EVEN THOUGH WE WERE ABOVE MVA, THE COMBINATION OF RISING TERRAIN AND ACFT DSCNT RATE MAY HAVE CAUSED THE GPWS TO GIVE ITS WARNING.

242560 JUST AS WE CROSSED OVER THE PEAK OF THE MOUNTAINS BELOW US WE RECEIVED A GPWS 'TERRAIN' WARNING. ... THE UNDERLYING TERRAIN WAS CLRLY IN SIGHT AT ALL TIMES AND AN EVASIVE CLB MANEUVER WAS NOT NECESSARY. I HAVE RECEIVED MANY UNNECESSARY GPWS WARNINGS IN THE TRI AREA, ALL OF WHICH HAVE OCCURRED WHILE UNDER RADAR VECTORS FOR A VISUAL OR INST APCH. THE MINIMUM VECTORING ALTS IN THE AREA ARE OBVIOUSLY TOO LOW AND SHOULD BE RAISED IMMEDIATELY. I DO NOT CONSIDER THESE TO BE 'FALSE' GPWS TERRAIN WARNINGS BECAUSE THE SYS APPEARS TO BE FUNCTIONING AS INTENDED. THE ATC VECTORING ALTS SIMPLY BRING THE ACFT TOO CLOSE TO RAPIDLY CHANGING TERRAIN. EVERY TIME A PLT RECEIVES AN UNNECESSARY GPWS WARNING HIS CONFIDENCE IN THE SYS IS UNDERMINED, MAKING HIM LESS LIKELY TO RESPOND PROMPTLY AND PROPERLY IN THE CASE OF A VALID WARNING. WE WILL CONTINUE TO EXPERIENCE CFIT ACCIDENTS UNTIL UNNECESSARY GPWS WARNINGS ARE ELIMINATED...

3.2. Other terrain-related incidents (4)

Incident 156284 involved confusion regarding charts in context of terrain.

156284 WHILE CLBING THROUGH 12500' MSO APCH ASKED US TO CROSS 8 NE ON V187 AT 11000'. I RESPONDED THAT IT WOULD BE NO PROB, WE WERE ALREADY ABOVE 11000'. THE CTLR STATED THAT WE WERE TO MAINTAIN 11000' TILL THE MSO AND NOW TO MAINTAIN 11000' TILL 8 NE OF MSO VOR ON V187. BOTH THE F/O AND MYSELF WERE SURPRISED BECAUSE OF THE CHARTS AND TERRAIN IMPLIED THAT IT WAS AN AT/OR ABOVE CLRNC.

Incident 297695 involved problems with crew coordination.

297695 I MISREAD THE DEP TO MAKE A L TURN AT 9000 FT WHEN I SHOULD HAVE MADE A R TURN. WAS CLR WX AND IN A MOUNTAINOUS AREA WHERE I WAS LOOKING OUTSIDE TRYING TO AVOID ANY TERRAIN OR OTHER ACFT AND SIMPLY MADE THE WRONG TURN. ... I BELIEVE IT COULD HAVE BEEN PREVENTED BY BETTER CREW COORD PRIOR TO DEP... BOTH PLTS WERE THE CAPTS ... THE BRIEFING BY THE CAPT FLYING MAY HAVE BEEN MORE THOROUGH IF HE WERE FLYING WITH A COPLT.

Incident 184446 involved procedures not followed and lack of detailed obstacle information on approach charts.

184446 THE FLC DID NOT REVIEW OR HAVE THE SAT RADAR-1 APCH PLATE DISPLAYED. ... [The controller] SAID TO DSND TO OUR MDA OF 1200 FT, AND KEPT TELLING US TO CORRECT HDGS TO THE R AS WE WERE L OF CENTERLINE. ... WE STARTED PICKING UP THE GND AND THEN SAW A 'VERY TALL TWR' AT 1459 FT AT OUR 2 O'CLOCK POS WHICH WAS APPROX 1/2-1 MI AWAY (THE TOP OF THE TWR BEING MUCH HIGHER THAN OUR ALT). JUST THEN THE CTLR GAVE US ANOTHER HDG CORRECTION TO THE R TO CENTERLINE. WE TOLD HER THAT WE COULD NOT ACCEPT THIS HDG BECAUSE IT WOULD TAKE US INTO A TWR. SHE SAID CHK YOUR MDA ALT OF 1200 FT. SHE APPARENTLY DID NOT KNOW ABOUT THE 1459 FT TWR. ... I CALLED SAT APCH ON ARR SAT AND SPOKE WITH A SUPVR. HE APPARENTLY WAS NOT AWARE OF A PROBLEM NOR OF THE RADIO TWR ON THE RWY 21 APCH.

Incident 264952 involved terrain-related data.

264952 I BECAME EXTREMELY ALARMED WHEN I LEARNED THAT HIS CALCULATIONS WERE BASED ON THE USE OF MINIMUM SAFE ALT DATA AS DEPICTED ON COMMERCIAL APCH PLATES AND NOT ON TOPOGRAPHICAL CHARTS OR COMPLETELY ON MEA INFO FROM ENRTE CHARTS. ... THE COMPANY RECENTLY FIRED 2 CREWMEMBERS FOR REFUSING TO TAKE A DRIFTDOWN DEPENDENT FLT THROUGH THE ROCKIES. THEY ASSERT THEY WERE NOT GIVEN ENOUGH TIME OR INFO TO COMPUTE THE ACFT PERFORMANCE FOR THE TRIP, AND HENCE REFUSED IT. THIS IS THE CLIMATE OF THE PLACE WHERE I WORK: EXTREME DURESS AND CONSTANT FEAR OF LIVELIHOOD LOSS. ... I DO NOT BELIEVE THAT THIS DATA HAS BEEN EVEN SUBMITTED TO THE FAA, LET ALONE SCRUTINIZED BY AN ENGINEERING TEAM.

4. Problems with operations in foreign airspace (6)

4.1. Problems with operations in Latin America (4)

Incidents 310143 and 140711 involved operations in the vicinity of Cali, Colombia, near the site of the crash of Flight 965.

310143 ATC CLRED US DIRECT TO THE CALI VOR AND DSND TO 5000 FT. ... FURTHER CHKING...SHOWED TERRAIN AT 14000 FT TO 11000 FT DIRECTLY ALONG OUR PATH. A SIMILAR ATC CLRNC HAPPENS VERY OFTEN FLYING INTO LIMA, PERU. MANY, MANY, MANY PLTS ARE NOT AWARE OF JUST HOW CRUCIAL IT IS NOT TO ACCEPT THESE DEADLY CLRNCS. PLEASE GET THE WORD OUT AGAIN.

140711 BARRANQUILLA CTL CLRED US DIRECT TULUA VOR. AS WE WERE PASSING ABEAM CARTAGENA VOR, AN LGT Y CROSSED OUR NOSE HDG IN A NE DIRECTION. IT WAS EXTREMELY CLOSE AND WE ARE SURE HE WAS AT OUR ALT BECAUSE WE HIT HIS WAKE TURBULENCE AS WE PASSED BEHIND HIM. ... BARRANQUILLA CTL STATED THAT HE WAS CTLING NO OTHER ACFT IN OUR AREA AT FL330. IN THE FUTURE, I WILL NOT ACCEPT AN OFF AIRWAYS CLRNC WHEN NOT POSITIVE OF BEING IN RADAR CONTACT. CTLR STATED THAT SOMETIMES ACFT TRANSVERSE HIS AIRSPACE THAT HE WAS NOT CTLING.

349669 I BELIEVE THIS WAS A CLASSIC SIT OF A FOREIGN ATC LANGUAGE BARRIER. ...I HAD NEVER BEEN TO MANAGUA BEFORE... SHE SAID 'RPT 5 DME RWY 9.'... WE BOTH ASSUMED WRONGLY THAT SHE HAD MEANT RPT 5 DME OUT ON FINAL ON THE APCH TO RWY 9. ... AS WE WERE TURNING FINAL AT APPROX 9 DME FROM THE RWY THE

CTLR ASKED OUR POS AND ALT. WE RESPONDED WITH, 'ON FINAL, 9 DME AT 2700 FT AS PUBLISHED.' SHE THEN SAID THAT WE WERE TO HAVE CALLED 5 DME FROM THE VOR AND CROSSED THE VOR AT 5000 FT.

334006 TCASII SCREEN SHOWED TFC 12 O'CLOCK, 800 FT BELOW US AND CLBING! ... I TURNED THE ACFT R AT THE LAST MOMENT BECAUSE WE FINALLY SAW NAV LIGHTS OF THE OTHER ACFT AT OUR 11:30 POS. ... I HAVE BEEN FLYING THIS AIRSPACE FOR OVER 5 YRS NOW AND WITH THE HORRENDOUS ATC (AND/OR UNSCRUPULOUS LATIN AMERICAN OPERATORS FLYING ANY ALTS THEY WANT) THERE WILL BE A MIDAIR COLLISION BEFORE TOO LONG ... WE NEED, AND THE TRAVELING PUBLIC SHOULD DEMAND, SATCOM AND BETTER ATC THAN THIS ARCHAIC LATIN AMERICAN SYS, NOTE ALL THE IATA AIRWAYS ON MAPS WHERE 'ATC IS OF DUBIOUS QUALITY'...

4.2. Problems with operations in other foreign locations (2)

Incident 244767 is reminiscent of the August 1997 crash of Korean Air Flight 801 on Guam (McKenna, 1998b).

244767 SCHEDULED PART 121 FLT FROM SPN (SAIPAN) TO MANILA, PI (MNL). WX AT THE TIME WAS RPTED 1 KM TO 1 1/2 KM IN HVY RAINS...COMS DIFFICULT AT BEST DUE TO POOR EQUIP AND CTLR'S HVY ACCENT. ... ATIS INFO NEVER SPECIFIED APCH IN USE OR IF ANY PART OF ANY APCH SYS WAS NOT IN SVC. APCH CTLR STATED 'APCH TO RWY 24 IN USE.' WE (ALL 3 PLTS) BRIEFED THE ILS 24 APCH ... I STATED SEVERAL TIMES THE ILS FREQ IS NOT IDENTING. THIS, SAD TO SAY, IS NOT UNUSUAL IN MANILA DUE TO VERY POOR GND EQUIP. CTLR VECTORED US ON THE INTERCEPT HDG AND THEN CLRED US FOR THE 'RWY 24 APCH.' THE CAPT (PF) CAPTURED THE LOC AND GS AND BEGAN TO LET DOWN. AT MINIMUMS, ARPT WAS NOT IN SIGHT SO A MISSED APCH WAS EXECUTED. TO OUR DISMAY, THE OMEGA READ 7 MI FROM THE ARPT. WE WERE 7 MI NE OF THE ARPT AT 400 FT!

305840 APCH CTL VECTORED US W THROUGH FINAL AND THEN BACK. THE APCH WAS NOT IN THE FMS DATABASE AND BOTH PLTS WERE USING RAW DATA. AS WE SAW THE DEV BAR BEGIN TO CTR, THE CAPT (WHO WAS HAND FLYING) CALLED 'ARPT IN SIGHT.' IT WAS APPARENT THAT WE WERE TOO HIGH AND A FEW SECONDS (5-10) LATER THE FO AND I REALIZED THIS WAS NOT THE NAGOYA ARPT. THE VISUAL APPEARANCE WAS SIMILAR, BUT RWY HDG WAS 30 DEGS OFF AND NOW WE WERE E OF THE FINAL APCH COURSE, AND STILL APPROX 9 MI NNE OF NGO. ... LANGUAGE AND PHRASEOLOGY WERE DEFINITELY A FACTOR. IT WAS NOT QUITE CLR, AFTER SEVERAL QUERIES, IF WE WERE CLRED FOR THE APCH OR WERE STILL ON VECTORS. A 'HEADS UP' CALL THAT ONE MIGHT EXPECT IN CONTINENTAL UNITED STATES SUCH AS 'ARPT AT 2 O'CLOCK, 9 MI,' IS NOT USED IN JAPAN OR OTHER ASIAN COUNTRIES THAT I'M AWARE OF. THE CAPT WAS NEW TO INTL FLYING AND TO THE ACFT (4 MONTHS APPROX) AND SAW WHAT HE EXPECTED TO SEE AND MADE A QUICK DECISION BASED ON LIMITED INFO.

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Appendix 7.

Excerpts of each of the 16 incidents
that were rated relevant by QUORUM but not by the analysts

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Appendix 7. Excerpts of each of the sixteen incidents that were rated relevant by QUORUM but not by the analysts. The 16 incidents fall into 9 categories. The first two incidents involve GPWS alarms, and are clearly relevant. The incident involving an escape maneuver is also relevant. The incident describing problems and confusion with terminal area charts seems somewhat relevant, as does the incident involving speed brakes. The six incidents involving FMS and approach, or approach/descent, are only vaguely relevant. Three incidents involving ACCIDENT are not relevant, nor are the two incidents involving CIVIL or FAA/SAFETY. So, of the 16 incidents rated as irrelevant by the analysts but rated as relevant by QUORUM, 5 are clearly irrelevant, 6 are vaguely relevant, and 5 are relevant.

1. GPWS alarms

Since this incident involved an event that also occurred in the Cali accident, a GPWS alarm, this incident is relevant. Further, it illustrates crew reluctance to respond to the GPWS when it is perceived to be giving a false alarm. This issue is clearly relevant to CFIT accidents. Still, one analyst strongly disagreed that incident 228422 has any relevance or similarity to the Cali accident.

228422 THE GPWS GAVE REPEATED 'TERRAIN, TERRAIN, WHOOP, WHOOP, PULL UP' WARNINGS. SINCE WE WERE IN DAY VMC FLT CONDITIONS AND COULD CLRLY SEE THAT WE WERE NOT IN DANGER OF A GND COLLISION, WE DID NOT PULL UP. AFTER REPEATED WARNINGS, WE SELECTED THE GPWS OVERRIDE TO SILENCE THE AURAL WARNING. ... THIS SAME TYPE OF INCIDENT HAS OCCURRED WHILE FLYING THE LOC/DME BACK COURSE RWY 8 APCH AT MARTINSBURG, WV, AND WHILE BEING VECTORED AT ROANOKE, VA. ... TO BE REQUIRED TO EXECUTE AN ABRUPT PULL UP WHILE FLYING A PUBLISHED PROC DOES NOT ENHANCE SAFETY. ON THE OTHER HAND, THE RECORD WILL SHOW THAT THERE HAVE BEEN A NUMBER OF ACCIDENTS THAT OCCURRED BECAUSE FLCS ELECTED TO IGNORE THE GPWS AND CONSEQUENTLY COLLIDED WITH THE GND. THE DESIGN CRITERIA FOR THE GPWS AND THE TERMINAL INSTS PROCS SHOULD BE CORRELATED TO PREVENT THESE FALSE WARNINGS.

Incident 280922 involved an event that also occurred in the Cali accident, a GPWS alarm, so this incident is relevant.

280922 BELOW 1000 FT WE GOT A GPWS 'TOO LOW TERRAIN' AND 'TOO LOW GEAR' WARNING AT THE SAME TIME THE TCASII WAS TELLING US TO DSND. ... DEP CTL THEN CALLED TO INQUIRE ABOUT OUR CLB OR LACK OF CLB AT ABOUT THE SAME TIME THE GPWS BURPED 'TOO LOW TERRAIN' OR 'TERRAIN, TERRAIN.' THE CONFUSION AND TENSION IN THE COCKPIT WAS QUITE HIGH ... THE CAPT AND I AGREED THAT UNDER DIFFERENT CIRCUMSTANCES, SAY A LOW VISIBILITY TKOF OR AN ENG FAILURE AFTER TKOF, THAT THE CONFLICTING COMMANDS ('DSND, DSND'/'TERRAIN, TERRAIN') COULD EASILY CAUSE AN ACCIDENT.

2. Escape maneuver

Since incident 313511 involved an event that also occurred in the Cali accident, an escape maneuver, albeit in response to a windshear alarm, this incident is relevant. In fact, the Colombian report on the Cali accident stressed the relationship between windshear training and GPWS training:

> "Simulator training is the best method for pilots to extract maximum performance from large airplanes during a CFIT escape maneuver. Therefore, Aeronautica Civil urges the FAA to require a CFIT training program that includes realistic simulator exercises comparable to the successful windshear and rejected takeoff training programs."

The NTSB agreed:

> "Develop a controlled flight into terrain training program that includes realistic simulator exercises comparable to the successful windshear and rejected takeoff training programs and make training in such a program mandatory for all pilots operating under 14 CFR Part 121.(Class II, Priority Action) (A-96-95)"

Thus, incident 313511 is particularly relevant to the Cali accident.

313511 WITHOUT ANY NORMAL WARNINGS (AIRSPD LOSS OR GAIN, SINK RATE CHANGE, ETC) WE WERE SUDDENLY GIVEN AN ON-BOARD 'WINDSHEAR' ALERT (AURAL AND RED LIGHT). I IMMEDIATELY EXECUTED AN ESCAPE MANEUVER (MAX FIREWALL PWR, 20 DEGS NOSE UP) AS ACFT BEGAN DSNDING. ... I AM ONLY GLAD THAT I JUST COMPLETED ANNUAL RECURRENT TRAINING IN WHICH WINDSHEAR TRAINING WAS AN EMPHASIS ITEM. I DID NOT HESITATE TO INITIATE THE ESCAPE MANEUVER, BUT I'M NOT CERTAIN THAT I WOULD HAVE DONE SO IMMEDIATELY IF I HADN'T JUST HAD THE NEED FOR 'IMMEDIATE AND DECISIVE' RESPONSE EMPHASIZED IN THAT TRAINING!!

3. Charts and confusion in the terminal area

Incident 112422 raises questions about the clarity and adequacy of some terminal area charts. The themes of confusion in the terminal area and confusion regarding charts also appear in the Cali accident. Thus, this incident is relevant. Perhaps the fact that this incident involved a general aviation pilot convinced the analysts that it was not relevant.

112422 I WAS INBND TO SAN DIEGO'S MONTGOMERY FIELD FROM SANTA BARBARA VIA VAN NUYS, POMONA, AND OCEANSIDE VORS. ... I ASKED THE CTLR TO VERIFY THAT I HAD CLRNC INTO THE TCA. THE RESPONSE WAS "YOU'VE BEEN IN THE TCA FOR SEVERAL MINUTES"... SINCE THE SAN DIEGO TCA CONSTITUTES THE MOST CONFUSING MAZE OF AIRSPACE I HAVE TO DATE ENCOUNTERED, I HAD CONDUCTED VERY CAREFUL FLT PLANNING TO AVOID LAX TCA AND TO PLAN FLT INTO MONTGOMERY ON ROUTES AND ALTS AVOIDING THE SAN TCA. IN THE COURSE OF THAT FLT PLANNING I OBSERVED SEVERAL CRITICAL OMISSIONS ON THE SAN VFR TERMINAL AREA CHART. THE QUEST FOR "ALL AVAILABLE INFO" REQUIRED BY FAR 91.5 SHOULD BE AIDED, NOT HINDERED, BY THE CHART-MAKERS, AS FOLLOWS: ...

4. Speed brakes

Incident 340978 centers on a problem with speed brakes that began during descent. Speed brakes also played a central role in the Cali accident. On that basis, this incident is relevant. It is reasonable to suggest that an accident investigator might want to explore speed brake incidents to see if there are any operational difficulties that might be related to the Cali accident. As indicated by incidents 334866 and 280233 in appendix 6, section 2.3., "Forgot speed brakes," the use of speed brakes is a topic worthy of investigation. Thus, reports of problems with speed brake have some relevance.

340978 ON DSCNT INTO SFO I TRIED TO ARM THE SPD BRAKES BUT COULD NOT GET A GREEN SPD BRAKE ARMED LIGHT, JUST THE SPD BRAKE DO NOT ARM LIGHT. SO I STOWED THE SPD BRAKE LEVER IN THE DOWN DETENT POS (NO LIGHTS). WE USED FLAPS 40 DEGS FOR THE FLAP SETTING. I PLANNED A LONG ROLLOUT (ANTI-SKID INOP, MANUALLY SPD BRAKE, REDUCED BRAKING). ... WHEN I TRIED TO USE THE REVERSER THEY WOULD NOT DEPLOY, IT TOOK A COUPLE OF TRIES. THEN WHEN THEY DID DEPLOY I NOTED THAT THE SPD BRAKE HANDLE MOVED TO THE UP POS BY ITSELF AND AT THAT POINT IN TIME WHAT SEEMED TO ME AS BRAKING OR STRONG DECELERATION, ALL THIS WITH VIOLENT SHAKING. BRAKES WERE NOT BEING USED BY ME OR THE FO.

5. Use of automation on descent/approach

Incident 308422, like the Cali accident, involves letting automation fly the aircraft in a demanding environment during descent/approach. While the turn in this incident was intended, both the incident and the accident involved safety concerns associated with turns initiated by automation. This incident is vaguely relevant to the Cali accident.

308422 I WAS LETTING THE FMS AND AUTOPLT FLY THE ARR. ... THE FMS STARTED THE TURN FROM DARTS TO FINAL APCH APPROX 2 MI PRIOR TO DARTS. THE FMS IS DESIGNED TO DO THIS SO THAT THE ACFT WILL NOT OVERSHOOT THE NEW COURSE. ... SOCAL APCH [said] THAT WE HAD INTRUDED INTO ANOTHER CTLR'S AIRSPACE BY STARTING THE TURN EARLY AND ADVISED THAT WE NOT LET THE FMS FLY THE AIRPLANE IN LOS ANGELES BASIN.

6. On approach

These incidents are, at best, only vaguely relevant to the Cali accident. They involve some sort of problem while on approach, but have little else in common with the accident.

Incidents 370656 and 332870 describe parallel approaches to SFO. QUORUM picked up that there was a problem on approach, but misinterpreted the contextual association of "FMS" (flight management system) and "APCH" (approach) in the narrative.

370656 WHILE SHOOTING THE FMS BRIDGE VISUAL RWY 28R APCH TO SFO, APCH CTL CALLED OUR TFC AT 10 O'CLOCK HIGH AND THAT IT WOULD BE GOING TO RWY 28L. ... WE ACKNOWLEDGED THE TFC AND CONTINUED ON THE FMS APCH PASSING THE GAROW FIX (15 DME AT OR ABOVE 4000 FT) AS PRESCRIBED. ...WE THOUGHT IT ODD THAT HE WAS CRUISING RIGHT BY US, BUT FIGURED WE WOULD HAVE THE REQUIRED 1/8 MI STAGGER PRIOR TO TOUCHDOWN.

332870 SFO APCH CLRED US THE FMS RWY 28R APCH ... THEY THEN ADVISED US A B737 WOULD BE MAKING AN APCH TO RWY 28L. WE KEPT THE B737 AHEAD OF US BUT BARELY. THE REASON FOR THIS RPT IS THE APCH UPSET SEVERAL PAX ON THE L SIDE OF THE ACFT. THEY THOUGHT WE WERE WAY TOO CLOSE. I KNOW THIS INCREASES ARR RATES, BUT IT CAN BE UPSETTING TO PAX.

Incident 281636 happened during approach, but has little else in common with the Cali accident other than the crew having a problematic interaction with the controller. QUORUM over-interpreted the presence of the term "FLC" (flight crew) in the context of "APCH" (approach).

281636 ON THE QUIET BRIDGE VISUAL TO SFO RWY 28R APCH CTL CALLED OUT AN ACFT AHEAD. ... CTLR THEN CLRED OUR ACFT TO MAINTAIN 2500 FT AND 250 KTS. OUR ACFT WAS NOW APPROX 7 DME FROM RWY 28R. WE QUERIED THE CTLR ABOUT THE AIRSPD HE WANTED US TO MAINTAIN AND HE REPLIED HIS INTENTIONS WERE TO HAVE US OVERTAKE THE ACFT THAT WAS AHEAD, BELOW AND TO OUR L... AT APPROX 6.5 DME WE TOLD THE CTLR THAT UNLESS WE COULD REDUCE OUR AIRSPD WE COULD NOT LAND. CTLR REPLIED BY HAVING US DISCONTINUE THE APCH. WE INFORMED THE CTLR THAT WE NOW HAD THE COMMUTER ACFT IN SIGHT AND THAT IT WAS ABOVE US AND BEHIND US. CTLR RESPONDED ROGER, MAINTAIN VISUAL WITH THE COMMUTER ACFT AND SWITCH TO TWR FREQ. WE SWITCHED OVER TO SFO TWR CTL AND INFORMED THE CTLR THAT WE COULD NOT MAINTAIN VISUAL WITH AN ACFT THAT WAS ABOVE AND BEHIND US. ... APCH CTLS DIRECTION TO HAVE A FLC MAINTAIN VISUAL WITH AN ACFT THAT IS ABOVE AND BEHIND THEM WHILE ON FINAL APCH IS NOT ONLY IMPRACTICAL, BUT IMPOSSIBLE AND DANGEROUS IF ATTEMPTED.

Incident 325365 happened during approach, but has little else in common with the Cali accident other than the crew misunderstanding the controller. QUORUM over-interpreted the presence of the term "FLC" (flight crew) in the context of "APCH" (approach).

325365 WE HAD ... BEEN GIVEN A NORTHERLY VECTOR FOR A VISUAL APCH TO LOS ANGELES INTL ARPT'S S COMPLEX. ... A JETLINER, ALSO FOR THE S COMPLEX, WAS APCHING LAX FROM THE E. ... THE CTLR ISSUED A VISUAL APCH CLRNC INTENDING FOR US TO MANEUVER OVER AND BEHIND HIS PATH FOR RWY 25R WHILE HE PROCEEDED TO RWY 25L.... WE MAY HAVE INADVERTENTLY ANTICIPATED THE CTLR'S INSTRUCTIONS AND PREPROGRAMMED OURSELVES TO HEAR AND BELIEVE THAT WE HAD BEEN CLRED FOR THE RWY 25L VISUAL APCH. ... HE BELIEVES THEY WERE NEVER CLOSER THAN 1/4 MI FROM THE B767. HE TALKED TO SOCAL APCH CTLR WHO INDICATED THE ACR FLC WAS UPSET BUT SOCAL INDICATED THEY WERE ON A VISUAL APCH AND SOCAL WAS NOT RESPONSIBLE FOR SEPARATION.

In the narrative describing incident 260432, the reporter provides a lengthy description of the details of a normal approach as a set-up for the sudden, abnormal, and violent roll excursions. QUORUM misinterpreted the detailed set-up as central to the incident. Mention of the flight data recorder also appeared to QUORUM to signify relevance.

260432 WE INTERCEPTED FINAL ABOUT 5 MI OUTSIDE THE FINAL APCH FIX AND PROCEEDED TO FLY A NORMAL APCH USING THE FMS/ILS AND STANDARD ACR PROCS. AN APCH CHK WAS RE-ACCOMPLISHED TO IDENT THE RWY 36R LOC AND CONFIRM THE NEW MINIMUMS FOR THAT APCH. ... AT ABOUT 500 FT AGL, THE COPLT DISCONNECTED THE AUTOPLT, AND BEGAN TO HAND-FLY THE ACFT, WITH THE AUTOTHROTTLES STILL CONNECTED. ... LATER ANALYSIS OF THE FLT DATA RECORDER DID NOT SHOW ANY DISCERNIBLE DIFFERENCE BTWN THE AUTOPLT AND COPLT FLYING. ... AS THE RWY THRESHOLD LIGHTS WERE PASSING UNDER THE NOSE, THE ACFT ENTERED INTO A SERIES OF ABRUPT AND VIOLENT ROLL EXCURSIONS WHICH I ESTIMATE TO BE IN THE RANGE OF 15-20 DEGS OF BANK. THERE WERE 3 OR 4 OF THESE ROLL REVERSALS, WHICH ENDED AS ABRUPTLY AS THEY BEGAN. AT THIS POINT, I WOULD ESTIMATE THE ACFT ALT AT ABOUT 15 FT...

7. "ACCIDENT" in the context of "PLTS" or "TRAINING"

The words "ACCIDENT" and "PLTS" are rare in the ASRS database, but are much more common in the Cali documents. Once QUORUM had already identified the more obviously relevant reports, it over-interpreted the relevance of those, like incidents 342160 and 360500, having words such as "ACCIDENT" in the context of "PLTS" (pilots).

342160 WE DO AERIAL FIRE-FIGHTING -- OUR MISSION IS LOW LEVEL AND VERY INTENSE FLYING. I AM CONCERNED NOT ONLY FOR OUR AGENCY PLTS, BUT ALSO FOR THE CONTRACT AIR TANKER PLTS. IF YOU CHK OUR ACCIDENT RECORD, YOU'LL SEE WHY I'M CONCERNED. WE ARE REQUIRED TO WORK EITHER 12 DAYS ON AND 2 DAYS OFF OR 6 DAYS ON AND 1 DAY OFF -- OUR DUTY DAYS AVERAGE 10-12 HRS.

360500 LCL PLTS PERSISTENTLY TAXI ON RWY 04/22 AT THE INTXN OF TXWY A WHEN INSTRUCTED TO TAXI TO RWY 29. TRANSIENT PLTS WILL REMAIN CLR OR HOLD SHORT OF RWY 04/22 UNLESS AUTH BY ATC. THIS IS AN ACCIDENT WAITING TO HAPPEN AT THIS FACILITY BECAUSE THE ONLY PLTS THAT ACCESS RWY 04/22 WHEN INSTRUCTED TO TAXI TO RWY 29 ARE LCL PLTS ...

Incident 325432 looked relevant to QUORUM primarily because of the proximity of "ACCIDENT" and "TRAINING." This pairing is rare in the ASRS database and more common in the Cali documents.

325432 I DEPARTED FROM FT LAUDERDALE EXECUTIVE ARPT WITH MR X, AN FAA SAFETY INSPECTOR/PLT ON A PART 141 TRAINING FLT. ... THIS TRAINING PERIOD WAS TO INCLUDE TOUCHDOWN AUTOROTATIONS. ... THE FAA HAS MADE THIS MANEUVER A REQUIRED ITEM IN THEIR CONTRACT DEMANDS FOR OUT OF AGENCY RECURRENCY TRAINING. ACCORDING TO PRELIMINARY ACCIDENT RPTS AS COLLECTED AND CIRCULATED TO THE HELI INDUSTRY, THE MOST COMMON TRAINING ACCIDENT INVOLVES THE PRACTICING OF TOUCHDOWN AUTOROTATIONS.

8. A "CIVIL" incident

Incident 148439 looked relevant to QUORUM primarily because of the presence of the word "CIVIL" in numerous QUORUM relations. The word "CIVIL" is rare in the ASRS database and common in the Cali document (due to references to the Colombian agency investigating the accident, Aeronautica Civil, and the International Civil Aviation Organization).

148439 SEVERAL CALLS WERE MADE TO THE TANKER REQUESTING A RPT OF HIS INTENTIONS, BUT IT SEEMED THAT THE TANKER WAS NOT ON FREQ. LATER I WAS ABLE TO CONTACT THE TANKER PLT BY PHONE AND LEARNED FROM HIM, TO MY GREAT SURPRISE, THAT HIS ACFT IN NOT EVEN EQUIPPED WITH THE VHF RADIOS NECESSARY TO COMMUNICATE WITH CIVIL AIR TFC! ... THE MIL WOULD LOOK ESPECIALLY BAD IF INVESTIGATORS DISCOVERED THAT THE CIVIL ACFT HAD BEEN IN COMPLIANCE WITH FAA RECOMMENDED RADIO PROCS AND THE MIL ACFT HAD NOT, BECAUSE OF HIS LACK OF BASIC RADIO EQUIP.

9. "FAA" and "SAFETY"

In the ASRS database, the words "FAA" and "SAFETY" usually do not describe operational details of incidents, but are occasionally found in general opinions that some reporters add to their narratives. In the context of accident investigations, however, these words are much more common, as in the Cali documents. QUORUM misinterpreted the prominence of relations containing "FAA" and/or "SAFETY" as an indication that incident 355188 is relevant to the Cali accident.

355188 WE WERE ON FAA PROVING RUNS ENRTE FROM IAH TO MCO. ... UNFORTUNATELY, OUR FAA AVIATION SAFETY INSPECTOR HAD SPECIFICALLY REQUESTED THAT WE DO NOT ADVISE ATC OF THEIR 'SIMULATED EMER,' BUT THAT WE WERE TO IMPROVISE PROCS TO 'EXPEDITE' A LNDG. IN AN ACTUAL EMER SIT SUCH AS THIS, ATC IS OUR PRIMARY AND MOST IMPORTANT RESOURCE, A RESOURCE DENIED TO US BY OUR AVIATION SAFETY INSPECTOR. ... DURING THIS DSCNT, I BRIEFED THE CREW FOR A LNDG AT DOWNTOWN ARPT, WITH THE FAA AVIATION SAFETY INSPECTOR OBSERVING THE BRIEFING.